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THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The National Electric Light Association ranks foremost among the bodies that represent the interests of the great public utility industries of the country. From whatever point of view it be regarded and considered—size of membership, age of the organization, representative character of its leaders, influence in the art, courage in dealing broadly with large issues—the association undergoes very favorable comparison with the kindred institutions that stand before the public as sponsors for street railways, gas plants, water-works, etc.; and its methods are often cited for study and emulation. And yet it is not fully a quarter of a century old, its first convention having been held in Chicago, in 1885.

Since the Buffalo convention in 1892, the meetings have been held annually, but up to that time, for the first eight years, they were held every six months. For this there were various reasons. From 1880 to 1890 the electric lighting art in America, and indeed throughout the world, was undergoing a series of technical revolutions, and was growing with tremendous rapidity. The men who entered the field were attracted from all quarters, were frequently unacquainted with each other, and often unfamiliar with the conditions of the business; but all of them adventurous spirits, eager for knowledge and perfectly willing to communicate to others the new facts that they learned themselves as they plunged in. It was almost inevitable that at the start the members of the young association should feel the necessity keenly for frequent sessions, and there were even some who regretted and withstood the change to a yearly convention. But time has shown the wisdom of the change, especially now that numerous State and sectional lighting associations have sprung up, so that not a month goes by without the opportunity for central-station managers to get together. It thus happens that in 23 years the association has held no fewer than 31 conventions, visiting for the purpose no fewer than a score of cities. One of these cities was Montreal, where in 1891 it gave a fine electrical exhibition and was fêted generously by the local authorities. As the association grew, the burden of entertainment was felt to be onerous by different places visited, and it was determined to alternate between Chicago and New York. This again was found to have objections, and the next convention city is never a certainty now. The farthest Western flight has been to Colorado, but there have been invitations to go further than that, while the officers entertain the hope some day of reaching the city of Mexico. Wherever the association goes now, with its average attendance of over 2000, it does marked good in a stimulus to the industry in the region visited; while in the earlier days its convention was found very helpful in that appeal to local pride which was just the thing needed to secure the renewal of the contract for street lighting or to prevent the passage of some obnoxious, arbitrary ordinance.

Including the present incumbent, the association has had 22 presidents, and these men as a group attest the versatility of talent enlisted and required in the field of illumination. Three of them were graduates of the telegraph key, but so far as known, no others had had any direct acquaintance with electrical work before becoming interested in the development of lighting properties. One came from the bench, another from the bar, while a third has been prominent in American finance for 30 years, and a fourth took active part in the development of the oil industry. Half a dozen are men of technical college training, but the great majority have mastered the central station art as they went along; while two of them have stood also at the head of great electrical manufacturing enterprises. One of them, a forceful, vigorous spirit, is as prominent in gas as in electricity, and absolutely without prejudice either way. This variety of talent has helped the association greatly, keeping it rounded and progressive, and a special element for good has been the fact that the body has never tied up meekly to the big corporations, but has gone after ability wherever it could be found. Waterbury, Conn., and Williamsport, Pa., have given two excellent and efficient presidents to an association which speaks for an investment of $1,000,000,000 and for 5000 companies earning in excess of $200,000,000 annually from supplying the public with electrical service or electrical energy. In fact, the one thing that reveals more clearly than anything else the broad-gage policy of the association is its unremitting work to get the smaller companies into membership for their own good.

And this brings us to a consideration of the actual work done by the association during its existence. Primarily, of course, the conventions have always been held for the sake of listening to papers and reports and discussing them. As the result, the Association's printed publications in the shape of annual proceedings and transactions now fill a long series of big volumes—nearly 5 ft. of shelf—in whose thousands of pages the history and evolution of the art are writ large. The first volumes are a rather curious study, showing how the young association was groping its way to light and life, trying to find its true function, and in the effort doing a few things that in its more mature years it looks back upon with an amused wonder, just as a grave man does on his own boyish pranks. But the latest volume of proceedings, that for the Chicago convention of 1908, gives a good measure of current achievement. There are over 900 pages of text, embodying the contributions of 40 authors of papers and reports, some of them the foremost men in the art, while the discussions carry the names of 100 other men. The present program is not less extensive in scope of work to be done at Atlantic City.

Some associations, as they get on in years, show their age and tend a little to incrustation and dry rot. The National Electric Light Association, strong and authoritative as it is, keeps young and lively as well by "playing up" its junior members. Its present president is one of the youngest men who ever filled the chair, and he is executing a policy that in some societies would be decried as sensational and unbalancing. But when examined, it is seen that the association is wisely driving its influence into new fields with all the momentum behind it of acquired weight and success. It has had several classes of membership—companies, employees of companies, supply concerns, etc., but under its newest and latest plan is affiliating on the one hand State associations and on the other central-station company branches and sections. It is thus creating a federal system of the highest importance, to which various States have already given their allegiance, and at the same time it is giving every official of a central-station company the chance to feel he is in touch with it and the opportunity to get its instructive, stimulating literature. The total membership last year was 1327, but the local company membership in such cities as Chicago, Brooklyn, Rochester and Philadelphia has already brought it up to 2000 more inside of the current year. An organization that thus reaches out in such opposite directions in order to find its fullest measure of usefulness is likely to send its roots down deep to the very well-springs of life and growth.

Grounding the Secondary.

In our issue of April 1 we printed an article by Mr. W. J. Canada giving the result of a canvass of central stations on the question of grounding the secondary. On page 1302 of this issue will be found a collection of replies received by Mr. Canada, confined, however, to those from central stations which accorded permission to make their communications public. A perusal of these opinions on the subject of grounding will increase the wonder in the minds of many who have been nonplussed at the apparent hostility of the National Electric Light Association to the practice of grounding, as expressed in the report of its committee adopted last year, the terms of which, if enforced, would prohibit central stations from grounding the secondary when the voltage exceeds 150. As will be seen from the communications printed, the central stations that have been grounding the secondaries do not report any objections to the practice, either with respect to cost of maintenance of circuits or loss of apparatus. On the other hand, there can be no doubt whatever that wherever grounding has been adopted, deaths from electric shock have been averted. Few probably realize how large is the toll of death from ungrounded secondaries. It is, in fact, so large that were general systematic publicity given to all of the cases which come to the knowledge of this journal alone, electric lighting would be severely handicapped before the public on the score of its danger to life. The underwriters have, on the grounds of humanity and against what they consider to be their financial interest, favored the grounding of the secondary. The American Institute of Electrical Engineers and the Association of Edison Illuminating Companies have registered their approval of the practice. Whenever the subject comes up for discussion at State or other electric light bodies, the opinions expressed in favor of grounding invariably predominate. The national representative of the electric lighting industry, through its committee having cognizance of the subject, thus stands alone in apparent opposition to this means of protection to life, and, moreover, does so without offering any reasonable grounds for the position assumed. The lack of sympathy of the more progessive central-station men toward this attitude is indicated by the rapidly increasing adoption of grounding. If the N. E. L. A. persists in its recent policy with respect to grounding, the result may be to reopen before the public at large the question of the danger of electricity, lead to decisive action on the subject by law-making bodies, and place the industry at large before the public in the unenviable light of ignoring through motives of parsimony the humane reasons which call for the universal grounding of the secondary.

THE OPERATION OF LARGE GENERATING SYSTEMS.

One cannot read the articles on operating features of large generating systems, printed elsewhere in this issue, without being impressed with the minuteness of organization involved. Success depends on reliability of service, which in turn hinges on intelligent management of operating forces, proper disposition of generating equipment and ample safeguard against interruption. Without rigorous system all would be chaos; and because of the personnel involved, coupled with the necessity for rapidity and accuracy of execution, simplicity must be its keynote. As an instance, witness the marshaling of every man connected with the operation of the two huge generating stations and 23 substations of the New York Edison Company by the sound of a whistle and the pressing of a button.

It is notable that each of the large cities mentioned has two main generating stations located in close proximity to each other. In favor of this concentration of equipment is the great advantage of doing away with the large amount of unproductive investment where a number of smaller stations is operated. The more energy that can be generated in one locality, the less the unproductive investment and unproductive labor involved. Moreover, investment in substations and distribution systems is more or less independent of the number of generating stations, and the transmission cost is so small a part of the total that a plant with a proper transmission voltage may be located without reference to the load, coaling facilities and ample water supply being the determining factors of the site.

Reliability of service under conditions of generation is insured by a judicious use of storage batteries, subdivision of the station or the running of two large stations in multiple, and extra care in operating the entire system. In most of the large systems duplicate underground transmission lines are used and secondary tie connections established between generating plants. The substations are supplied through independent sets of feeders following different routes, and the buses in the main station are arranged so as to secure two-bus operation. Every-day practice has so far shown that with these precautions continuous service is amply safeguarded. The load conditions differ in various cities as do also the angularity of the peaks and the amount of reserve apparatus that must be kept in readiness for emergencies. In Chicago, the day load is principally a railway load, so that a sudden thunderstorm would not call for the additional apparatus rendered necessary in New York, for instance, where 30 additional boilers are kept under steam all summer just to meet such emergencies. The rapidity with which large units can be got under way under emergency conditions is little short of marvelous, and to be able to carry a load increasing from 45,000 kw to 85,000 kw in 10 minutes speaks well for a system.

It is interesting to note the manner in which the organization of the working forces in large power houses proceeds along the same lines. As systematization is the vital feature of station operation, not only in large but in small plants, this uniformity is encouraging. In the larger plants, from the chief engineer, through assistant and watch engineers, to oilers, fireroom engineers, water tenders, firemen, coal passers, chief operators, assistant chief operators, watch operators, substation operators, etc., each individual has clearly defined duties and responsibilities. While constant supervision is necessary to keep the system up to standard and by means of drills its operators trained to the highest possible skill in their particular branch, when unforeseen conditions arise and the system as a whole is subjected to test, every man then knows his duty and does it.

ENLARGEMENT OF THE FIELD OF THE CONSULTING ENGINEER.

When the old-fashioned orthodox novel was in its heyday, Lorenzo and Clarinda were married in about the penultimate chapter, triumphing over the machinations of villainy and the trials of circumstances, while the conclusion was devoted to the statement that they lived happily ever after and to a neat bestowal of all the subordinate interests of the narrative. The story ended there. But writers of present-day fiction evince a tendency to discuss what happened "after," and while their studies of social problems are sometimes wearisome, or perhaps even a pretense to cover an unworthy object, on the whole they have enlarged the field of the story-teller's art and given it greater breadth and strength. Perhaps it may be permissible, if no one's dignity is offended, to point a parallel in the case of the work of the consulting engineer. The engineer makes examinations, prepares reports, designs plants; but is it not usually the case that his work is considered done when the plant is finally put into operation, tested and accepted? He has told his "story," told it well usually; but what happens after? Of course, if the installation is a very large one, belonging to a strong owner with modern ideas, it is probable that it will be operated by a chief engineer of ability and resource, very likely the peer of the designing engineer in professional attainments. This is notably the case with the large electric-service plants of various kinds in the United States. But consider the case of smaller concerns, with power plants intended either for public or private service. Do the men responsible for the operation of these smaller plants never need outside advice and assistance? Are they not often overworked, with no time or inclination, possibly no particular aptitude, to devise economies? Is there not a field here for an extension of the work of the consulting engineer—an extension which would be profitable both to the engineer and to his client?

Taken by and large, it is probably true that comparatively little attention is given to the operating end of the business by consulting engineers. The latter are keen on making installations of engines or waterwheels, dynamos or motors. But very often owners of plants that have been installed for some time can be advised to their advantage of economies in operation or improvements in administration that may be effected. Perhaps the private plant owner, for example, should install the electric drive. Perhaps he should buy his electric energy rather than make it; perhaps the reverse is true under some particular conditions. If the plant owner is a customer of the central station, perhaps he should be advised how best to make use of the energy in the form of electricity brought to his premises. And the central-station manager in charge of the medium-sized plant—may not he also consult with profit the consulting operating engineer, with the latter's wide horizon and experience? Even if the manager is himself an engineer or has a competent chief engineer to operate the plant, it sometimes happens that one may not see the forest for the trees, and that unprejudiced examination and assistance may prove highly valuable.

Articles presented in this issue give some idea of the vigilance, minute attention to economy, careful supervision of detail and the elaborate safeguards to insure reliable and continuous service which are lavished on large central-station plants. In smaller public-service plants, much less in private plants, it is hardly practicable, of course, to duplicate these expensive organizations and large operating staffs. But nevertheless these articles may indicate to many a plant owner directions in which operating conditions may be improved. And by showing what is done in highly specialized organizations, they induce the further reflection that there is undoubtedly a greater field for engineering work in improving actual operating conditions in old-established plants than has yet been cultivated. May not the consulting engineer, then, increase his usefulness by giving more attention to operating, paying as much attention, perhaps, to operation as to construction? Or must this become a separate branch of the profession?

Prices for Public Lighting.

At the present time the municipal market for light is what one might call disturbed under the effect of a bear raid. Fortunately for the long element, it is fairly well margined and not easy to shake out, although some holders have taken fright and unloaded at a sacrifice. The fact is that until some standard basis of values for different grades of the commodity concerned is reached the market will necessarily be depressed. It is much as if the cotton market, all cotton, from waste to Sea Island, were lumped as cotton, and the prices quoted just as sales came without any attempt at further specification. Hence it is but natural to expect all sorts of prices to appear until sales are in a measure systematized. As a rule, recent contracts for lighting have shown large reductions over old rates, yet the significance of such reductions is not always apparent. The whole electrical industry has been passing out of the exploiting era into one of straightforward, business-like, ordinary manufacturing, and with the resulting greater stability, fancy prices have vanished. Yet, on the other hand, the normal costs of both fuel and labor have moved upward, and such lessened costs of production as have been attained have been by reason of heavy investments in equipment, which must be taken into account. Undoubtedly in the case of very many plants the cost of energy at the bus-bars has been greatly reduced in the last decade, but this is not at all the whole story.

The busbar costs customarily quoted, and on which estimates of such a reduction are likely to be made, do not include interest on the investment and depreciation of the equipment. They do include a certain element of depreciation in the form of up-keep charges, yet the heavier depreciation, which means periodic replacements of the plant, is left out. If this is not taken care of by a sinking fund, or its equivalent, it is bound to appear sooner or later as an investment charge or as an extra burden elsewhere. If one runs back over the history of electric lighting, the number of wholesale changes in the art requiring re-equipment as a matter of preserving the value of the system is rather startling. From small arc machines to big ones, from these very often to constant-current transformers, and from these again to mercury-arc tubes; from open arc to enclosed and then back again to luminous arcs; from arcs to carbon incandescents and then to tungsten—all these have compelled heavy reinvestments in one form or another. From whatever standpoint one looks at these costs, or into whatever place in the books they may go, the fact remains that a very large amount of real money has been used up and stands as a legitimate, if unfortunate, charge against the business. The fair selling price for the product cannot be determined until these things are taken into account in one way or another. But the costs of energy that the public hears about are merely those of the dynamo and boiler rooms in nine cases out of ten; very instructive as far as they go, but that is all.

These simple generating costs have gone down as the art has progressed, but at what cost? If the whole mass of figures were available, we have a very strong suspicion that in many cases the actual reduction would be very much smaller than the apparent one. If the National Electric Light Association would quietly take up this investigation and determine to what extent generating costs, including all fixed charges against the station, have diminished, some vastly instructive figures would be obtained. To go on to the next stage of the inquiry, what has happened in the same period to the distribution costs? The ordinary arc lamp may be taken as requiring somewhere about 2000 kw-hours per year at the station, which at whatever cost it is manufactured would be salable if turned to other uses for about an average of $100. The distribution charges peculiar to an arc system must be taken into the reckoning at this point. As arc lamps are customarily installed in this country, the connected load per mile of high-tension circuit is about 5 kw to 10 kw. What would be the probable condition of a central station that held such an average all over its lines? The distribution costs have been steadily going up rather than down. Copper has ranged high, good insulation is soaring and the wage rates have tended steadily upward. Poles are getting scarcer and the demand for costly underground construction is incessant. Consequently, whatever saving has been made at the station must be partly or wholly offset by the expenses outside it. These also should be made the subject of a statistical investigation before the industry really knows where it stands in making new prices. In spite of all talk of corporate rapacity and that sort of thing, it is absolutely true that most cities have been getting the energy supplied for street lighting at a nominal price compared with that which would be necessarily charged a private consumer buying a similar amount of energy dribbled about at 5 kw to 10 kw per mile of circuit.

And this takes no account of the care and maintenance of the lamps system, be it arc or incandescent, or of the pains with which continuous service must be maintained. As things have been going of late, with lighting prices, profits on municipal lighting are small compared with what must be maintained on other classes of service. And the constant demand is for a higher grade of service at a lower price. Moreover, there is no standard by which comparisons may be fairly made between place and place. One city uses 5-amp alternating-current enclosed arcs on a moonlight schedule, and allows the wires to be run in any sort of fashion that is cheap; the next has 6.5-amp direct-current arcs burning all night and every night, with insistence on extension of underground service. One station has cheap water-power, or slack at a nominal price, and another burns high-grade coal at $7 per ton and hard to get at that. We believe the N. E. L. A. could do a great service by making a thorough investigation of the prices for public lighting charged all over the country, and bringing out not merely gross contract rates, but the conditions on which

they are actually based. If some little city is reported by its mayor to be getting 2000-cp arcs at $51.64 per year, it ought to be possible at once to assign the reason for the rate. Very likely the arcs are really 6.6-amp alternating run on moonlight schedule with cheap water-power over pole lines that would not be tolerated in any really civilized community. Or cut-throat competition may be in progress, or politics may be involved. It would be most useful if the N. E. L. A. could gather the facts and so classify them as to render a reasonably fair comparison between city and city. In addition, it would be exceedingly useful if some regular basis of comparison between the lights themselves could be established, perhaps even a candle-power rating, to bring the various things sold as arcs to a common measure. But no more illumination measurements down murky alleys, if you please!

INTERNATIONAL AGREEMENT ON PHOTOMETRIC UNITS.

As announced elsewhere in this issue, an international agreement is reported between England, France and the United States upon a unit of candle-power of luminous intensity to be known as the international candle. This is a matter of great importance in the world of electric lighting. No change is made in France, which adhers to the bougie decimale, nominally one-twentieth of the violle or molten platinum standard, but actually 0.104 carcel. In England, whatever small change may have been actually involved, is covered in specifications of the national pentane flame standard by reference to the amount of moisture in the air of the photometer room. In America, a reduction of 1.6 per cent in the standard of candle-power maintained at the Bureau of Standards will be involved, a change far too small to be detected by the ordinary member of the light-using public, and only capable of being observed by trained photometrists, although its effect on the lifetime of carbon-filament lamps will be very distinct. We may be profoundly grateful for this opportunity to see by the same candle that others see us, and to expunge from future note-books the burdensome cross-ratios between the various candle-powers of the contracting countries. We are left with the international candle and the Hefner, which is nine-tenths of the same, a blessedly simple ratio. Our thanks are due to those who have helped to bring this international agreement about, in which, we understand, several additional countries have already joined, while still others are favorably considering like action.

TRANSACTIONS OF INTERNATIONAL ELECTROTECHNICAL COMMISSION.

As announced in a news item two weeks ago, the *Transactions* of the council meeting of the International Electrotechnical Commission, held at London in October, 1908, has at last been published in a very presentable form. The editorial work in connection with such a publication, of international consequence, is naturally much greater than where the publication is merely a national or a local production. In the present instance, the publication appears in the two languages adopted as channels of expression by the commission, namely, English and French, these two languages running side by side, page for page, throughout the book. Consequently, the mere typographical task of securing an even distribution of the text, and of securing accuracy in the printing of both languages side by side, is worthy of considerable endeavor. The general secretary of the commission deserves commendation, in our judgment, for the care and effort at precision which the work manifests. Fifteen countries were represented at the council meeting. In the absence of an official delegate from the American Institute of Electrical Engineers, Mr. C. O. Mailloux, then in London, attended the sessions at the direct invitation of the honorary secretary. An address of welcome, given by the Rt. Hon. A. J. Balfour and reported in full, indicates a remarkably close and precise apprehension of the tasks and opportunities lying before the commission. The rules of the commission were ratified with a few good amendments. It is evident that the main outcome of the commission thus far has been cooperation and a spirit of mutual compromise. This is the more fortunate, because, at the first meeting of the commission, it seemed doubtful whether the various national interests of electrotechnical bodies could be harmonized as they should be, in order to promote a common interest. This outcome is of great promise for the future, and is worth more than actual resolutions would have been without this *entente cordiale*.

Referring to matters of detail, an inaccuracy of terms runs through the entire report. This has been participated in apparently by all parties concerned in the English-speaking representation and publication. It is that the question of an international unit of candle-power, or of luminous intensity, is reported and described as that of an international unit of light. This confusion of ideas and terms in regard to light and candle-power, which is not light but light per solid angle, is as distressing to photometrists as a similar confusion might be in ideas and terms of distance and velocity. The error has been carefully avoided by the French editor in the division of the presentation that appears in the French language. The inaccuracy is, however, merely indicative of the lack of precision which pervades the general domain of English photometric nomenclature. Some very interesting discussion appears in sub-committee proceedings relating to the subjects of international electrotechnical nomenclature and of international symbols and formulæ. The German delegates, with that national thoroughness which commands the admiration of the world, desired nothing less than the adoption of an international electrotechnical dictionary so as to have all terms authoritatively translated and defined. It was fortunately finally agreed that this was too ambitious a project and a more modest procedure was outlined.

This is a matter which presses heavily upon the English-speaking countries in the commission. England and the United States are so different in their climate, area, physical, political and social conditions, that it is very difficult to hold the terms of electrotechnology to the same definitions in both countries. The conditions defy terminology legislation in many cases. For instance, the term "busbars" ordinarily means, in the average case of British practice, massive copper conductors in a central station serving to connect the generators in parallel and supplying a low-tension or moderate-tension network for a fairly dense city or suburban distributing system. That meaning also applies in North American cities, like New York and Chicago; but in many American cases the busbars are comparatively small conductors performing the corresponding functions, say, in a 60,000-volt system. A definition, therefore, which might strictly apply to British practice might not include American practice. To bring into mutual precision the definitions of electrical engineering on both sides of the Atlantic by the

medium of correspondence alone, is an enormous undertaking if the glossary of terms is to be voluminous. The only hope for definitions that will be really helpful and binding internationally, is to commence with the smallest number that will serve and gradually to build up; otherwise there is a danger of having to unbuild and reconstruct. Other difficulties stand in the way of international symbols and notation in electrical engineering formulæ. Differences in language and in habit here make themselves felt. The only hope seems to lie in commencing with the smallest number of international symbols that will really have binding force upon the institutions and countries represented, and then to add slowly to the list as ripened opportunity may permit. Otherwise, attempted legislation of too many symbols at once may break down. We hope that this first volume of *Transactions* may be widely disseminated among all of the electrical engineering institutions of the world. It is a document of much importance, promising more.

Dazzling Headlights.

Some striking experiments on the effect of over-brilliant light on color perception were recently reported from railroad shops at St. Paul. A bill requiring the use of large electric headlights on all locomotives was pending in the Minnesota Legislature, and these experiments were directed toward establishing the effect of such lights on the train hands who had to face them. To a certain extent the conditions of the experiment were *ex parte*, inasmuch as the engineers on whom the headlight was being tested were compelled to line up squarely in front of it for some time instead of getting it as they naturally would on the road in occasional flashes. After dazzling the eyes of the engineers quite thoroughly, they were tried for their perception of colored signal lights, and it was at once apparent that exposure to the rays of the searchlight had in so far blinded them for signal lights that they could not be depended upon to recognize them. Four colors of lights were used in the test—red, green, yellow and white—and no one of the group of engineers tested was able after the exposure to the headlight to state correctly the 24 combinations of light which were shown him. This part of the test may be open to criticism because the inclusion of yellow and white made failure to determine between the two almost absolutely certain. It would have been indeed very remarkable had they been able to discriminate between the yellow and white lights after exposure even to the ordinary form of headlight used on locomotives. That they were unable to distinguish between the red and green lights is, however, a fact of serious significance, since these lights are reasonably easy to distinguish in the presence of any intrusive lights likely to be found at the present time along the railroad. It is undoubtedly true that very long exposure to the rays of an electric searchlight would be more than likely to produce serious temporary impairment of vision. A sufficiently bright light projected upon the retina is likely to produce permanent or long-enduring injury, even to almost total blindness in the area affected. Oculists note a few cases of this kind whenever a solar eclipse happens, owing to the careless exposure of the eye to full sunlight, possibly through field glasses at that. The use of very brilliant searchlights on street cars has been found to be generally objectionable, merely on account of its temporary dazzling effect, and this result must be enormously increased with the powerful searchlights in occasional use on locomotives. Legislatures would do well not to dabble with these technical matters without expert advice.

Playing the Limit with Gas.

We are interested to note that an exhibition of the widely heralded "Press-gas" is being made in Boston. Although limited to a single lamp in front of the office of the gas company, it appears to be a powerful example of the type having three of the large inverted mantles, similar to those used in Berlin and some other places on the Continent. "Press-gas" is merely ordinary illuminating gas worked at high pressure in the mains for the purpose of forcing the combustion, and driving the mantle to higher incandescence. It is in principle identical with the scheme long used in some gas machines for isolated plants, but the later developments utilize pressures far higher than have been thus used. The Boston experiment is said to be working at 2 lb. per square inch in the supply pipe; that is, at about 4 ft. water-pressure in the manometer. Press-gas started out quite moderately a few years ago at 10 or 15 in. water-pressure, and has been gradually creeping upward to 4, 5, and even 6 ft. It must not be supposed that such a pressure plays freely upon the mantle. It, in fact, is largely utilized in inspirating a large extra supply of air, and in thus maintaining a fiercer flame than would otherwise be possible. It enables, too, the burner to consume a large amount of gas in small compass. Burners of all sizes common abroad use from 25 to 35 cu. ft. of gas per hour, giving from 500 to more than 1000 cp, nominal, according to circumstances. The effect is, of course, very brilliant and striking.

From a practical standpoint the value of the system is somewhat doubtful. The considerable cost and trouble of maintaining and installing special distributing mains at high pressure is a rather serious matter from the economic standpoint, and such a system of mains seems to be necessary for the higher pressures now in vogue. There have been a number of systems introduced using local compressors worked by waste heat from the burner, in one case through the medium of a thermopile working an electric motor fan to pump up pressure. Several such schemes have been tried in London, but the tendency seems to be toward separate systems of mains. London has had some experience in "Press-gas" for several years past. It pays about the same price for a single "Press-gas" mantle as for an arc light. Indeed, at any ordinary price of gas, it is evident that the price per mantle cannot be low. Burning 30 ft. of gas per hour for the ordinary street-lighting schedule of about 4000 hours implies about 120,000 cu. ft. of gas consumed. In addition, there is the cost of mantles, of which the life is shortened by the high temperature, and the cost of the pressure supply, whether by separate mains or special devices at the posts. Altogether it is difficult to see how the system can be made economical in spite of the increased efficiency due to the pressure. Mr. Voysey, electrical engineer of the Streets Committee of the Corporation of London, made a series of tests last year on London streets lighted with "Press-gas" and flame arcs respectively, and reported that the former cost for equal illumination about four times the latter. Of course, flame arcs are more efficient, although costing more to maintain, than arcs of ordinary type, but, discounting this difference, it is still hard to see where the economy of the high-pressure gas comes in, interesting as the system is from a theoretical standpoint. Except in London and Berlin, it is comparatively little used. Berlin owns its own gas plant, and buys its electric lights, so that comparisons of cost are therefore difficult to make, although arcs and "Press-gas" are said

to be of about the same cost, comparing an open arc with a single mantle. The closely spaced double mantles used there must cost a pretty penny.

A DARING POWER TRANSMISSION PROJECT.

We have referred from time to time to the proposed power transmission from the falls of the Rhone near the Swiss frontier to Paris, a project which has been under way for several years past, and which now, although not fairly initiated, seems to have come within the range of practicability. A long report (referred to in the Digest) upon this project appears in *La Revue Electrique*, which report, being drawn up by Professor Blondel, would be worthy of more than a passing notice even if it concerned far less important matters. As our readers may recall, the promoters of this large transmission early sought the aid of M. Thury, and the early plans were worked out with especial reference to the use of the Thury constant-current system, which despite its unfamiliarity in this country, has made good already in a considerable number of important Continental plants installed during the past 20 years. According to Professor Blondel's report, however, the situation has changed for the better in that it is now possible under the French law to secure a private right of way for power transmission lines instead of having to depend entirely upon the public roads. This change, says Blondel, has altered the situation with respect to the methods to be employed by rendering possible the use of the three-phase system, which would hardly have been permitted at very high voltage along the public roads. Moreover, the possibility of a private right of way enables the distance from the power house to Paris to be cut down to about 250 miles, a distance not much greater than that for some years successfully spanned by the transmission from Colgate to San Francisco. Hence, while the original project was laid out for direct current on the Thury system and preferably with underground cables, the present one has been worked out both for direct current and for three-phase currents, and with overhead lines carried on steel towers. The amount of power to be transmitted is about 150,000 kw. The original plan was to use direct current at 120,000 volts, but at the present time Professor Blondel states that this limit can be passed without difficulty and the transmission can be accomplished at 150,000 volts to 160,000 volts, and perhaps even at 200,000 volts, thereby making it possible to take 150,000 kw into Paris at a line efficiency of about 90 per cent. The corresponding three-phase project Professor Blondel has worked out for 120,000 volts between wires and a frequency of about 25 periods.

The plan for the power station includes double horizontal turbines working under an effective head of about 67 m (220 ft.), each pair of double turbines yielding about 14,500 hp. Thirteen such hydraulic units would be required for the full utilization of the stream, and each unit would be direct-coupled to a three-phase generator, or a group of four continuous-current machines in case the Thury system is adopted. The unit machine proposed by Thury is somewhat startling in its output, which is no less than 1000 amp at 2500 volts, this large current being taken care of by means of two commutators. This is a very radical increase in size over any machines of the Thury system yet employed. Yet, considering the fact that two commutators would be available and the commutating-pole construction could be employed if desirable, 500 amp per commutator at 2500 volts, while a large output, does not seem without the bounds of reasonable practice. Certainly a 2500-kw, direct-current unit is big enough to command respect, and odd as the system seems to American eyes, it certainly must be taken seriously in view of the successful operation of previous Thury plants. An interesting modification proposed in connection with this plant is the employment of regulators to cut down the constant current to 500 amp or 600 amp during the hours of light load, thus reducing the loss on the line. At the receiving end of the line the customary motor-generators would be employed, the regulation being by shifting the brushes. In the case of using three-phase currents, each hydraulic unit would be directly coupled to a three-phase generator of 10,000-kw normal output, giving about 12,000 volts. This initial pressure would be stepped up by oil transformers to 120,000 volts for the transmission. The switching system would be planned for remote control following the practice usual in this country.

The propositions for line construction are decidedly interesting. Professor Blondel states that in case the direct current is tried, transmission by underground amored cables insulated for 200,000 volts would be seriously considered, the chief difficulty being the cost. Nevertheless, it is evident that the present scheme has been planned with aerial lines chiefly in view. The direct-current transmission would comprise two lines of six cables, these cables being carried on independent insulators placed upon cross-arms on steel towers, placed about 150 m (490 ft.) apart. Professor Blondel states that the question of insulation of direct currents at high tension is completely solved and that the experiments in Geneva by M. Thury up to 120,000 volts have demonstrated that the insulation is entirely successful and the loss at the insulators insignificant. For the three-phase line there would be four and ultimately six independent lines, 18 cables in all, operated in parallel. The insulators proposed in such a case are radically different from those with which American engineers are familiar, being large porcelain insulators with metallic umbrellas protecting the porcelain from drip. Professor Blondel regards this type of insulator as likely to be entirely successful even for the very high voltage proposed to be employed, and regards the security of the system as almost complete. It would appear, however, that he perhaps pays too little attention to the suspension insulator, which is in so successful use in the Grand Rapids-Muskegon plant, apparently laying too much stress upon the possibility of the cables swaying in the wind. In point of fact, where this suspension insulator has been employed it is found that swaying need not be seriously considered, and the system certainly is far sounder mechanically than the use of porcelain insulators carried upon pins and of such size to give anywhere nearly equivalent insulation. As regards the comparative merits of the two systems, Professor Blondel declines to commit himself regarding both as entirely practicable for the work in hand. From a commercial standpoint he considers the project a promising one and puts himself on record as believing that power can be laid down in Paris at a price permitting competition with electrical energy generated by steam. The capitalization required, however, will approach 100,000,000 francs, an amount not large for so important a work, but yet sufficiently great to require very careful investigation of the financial engineering end of the project, before investors will undertake it. We earnestly hope that the project will be put through, since the hydraulic power is admirable and the distance to one of the world's exceptional markets is certainly not beyond fairly conservative limits.

N. E. L. A. Atlantic City Convention Program.

Below is given the final program of the sessions of the National Electric Light Convention, to be held next week at Atlantic City. The general meetings will be held in Marine Hall, and the meetings of the parallel sessions as follows: Technical, Marine Hall; Accounting, Greek Temple; Commercial, Theater.

GENERAL SESSIONS.

First Session, Tuesday, 10 a. m.

President's Address; Announcements; Report of Committee on Uniform Accounting; Report of Committee on Progress, by Mr. T. C. Martin, New York; Private Policy, by Mr. Paul Lupke, Trenton; Report of Committee on State and Company Branches, by Mr. R. M. Searle, Rochester; Question Box, Mr. Alex. J. Campbell, Editor, New London, Conn.

Second Session, Tuesday 8:30 p. m.

Opening Address; Latest Developments in Street and Park Lighting, by Mr. J. W. Cowles, Boston; Methods of Manufacture of Incandescent Lamps, Carbon, Metallized, Tantalum and Tungsten, showing by samples various processes, by Mr. S. E. Doane, Cleveland; Illustrated Lecture, Quality of Light, by Mr. Paul Bauder, Cleveland.

Third Session, Wednesday, 10 a.m.—Manufacturers' Day.

Advanced Information Regarding Developments in Storage Batteries, by Mr. Joseph Appleton, Electric Storage Battery Company; The Regenerative Flame Lamp, by Mr. A. J. Mitchell, the Adams-Bagnall Electric Company; The Status of the Arc Light, by Mr. N. R. Birge, General Electric Company; Recent Types of Arc Lamps and Their Operation, by Mr. C. E. Stephens, Westinghouse Electric & Manufacturing Company; Report of Committee on Meters, by Mr. G. R. Green, Philadelphia; Future Requirements of Central Station Companies, by Mr. P. Torchio, New York; Some Recent Developments in Electrical Apparatus, by Mr. E. W. Allen, General Electric Company; Distributing Transformers as of Interest to Central Stations, by Mr. E. G. Reed, Westinghouse Electric & Manufacturing Company.

Fourth Session, Wednesday, 8:30 p. m.

Address by Hon. F. A. Vanderlip; Address by Mr. G. S. Graham, on The Electrical Industry.

EXECUTIVE SESSION, WEDNESDAY.

Report of Treasurer, Mr. John F. Gilchrist, Chicago; Report of Committee on Public Policy, Mr. Samuel Insull, Chicago; Report of Lamp Committee, Mr. W. W. Freeman, Brooklyn; Report of Insurance Expert, Mr. Wm. H. Blood, Jr., Boston.

TECHNICAL SESSIONS.

Mr. W. C. L. Eglin, Chairman; Mr. W. F. Wells, Vice-Chairman.

First Session, Thursday, 10 a. m.

Report of Committee on Gas Engines, by Mr. J. B. Klumpp, Philadelphia; Some Features of Condenser and Cooling Tower Design and Operation, by Mr. M. R. Bump, New York; The Use of Reactance Coils in Generating Stations, by Mr. P. Junkersfeld, Chicago; Unique Features in Power Plant Design, by Mr. G. L. Knight, Brooklyn; All-Day Efficiency Tests on Station Transforming Apparatus, by Mr. F. M. Farmer, New York; Transformers, by Mr. W. A. Layman; Low-Pressure Steam Turbines, by Mr. C. H. Smoot, New York.

Second Session, Thursday, 2:30 p. m.

Report of Committee on Grounding Secondaries, by Mr. W. H. Blood, Jr., Boston; Report of Committee on Protection from Lightning and Other Static Disturbances, by Mr. B. E. Morrow, Albany; Report of Committee on Overhead Line Construction, by Mr. Paul Spencer, Philadelphia.; Recent Developments in Secondary Distribution Work, by Mr. W. K. Vanderpoel, Newark; Requirements and Specifications for Extra High Potential Transmission Lines, by Mr. A. S. Ives, Poughkeepsie; Performance Specifications and Ratings, by Mr. W. L. Waters, Pittsburgh; Central Stations in Towns of Less than 4000 People, by Mr. J. S. Knowlson, Schenectady.

COMMERCIAL SESSIONS.

First Session, Thursday, 10 a. m.

Methods of Introducing Tungsten Lamps and Their Effect on Central-Station Income, Mr. W. H. Atkins, Editor, Edison Electric Illuminating Company of Boston; Practical Illuminating Engineering in Connection with a Commercial Department, by Mr. G. A. Swain, Public Service Corporation of New Jersey; Intensive Methods of Business Development, by Mr. John C. Parker, Rochester Gas & Electric Company; Can a Display Room Be Conducted Upon a Profitable Basis? by Mr. Frank B. Rae, Jr., New York; Advantages to Be Derived from Uniform Commercial Department Forms and Methods, Mr. C. N. Stannard, Editor, Denver Gas & Electric Company.

Second Session, Thursday, 2:30 p. m.

Compilation of Load Factors, by Mr. E. W. Lloyd, Editor, Commonwealth Edison Company; Paper, Electric Power, Mr. H. J. Gille, Editor, Minneapolis General Electric Company; The Advantage of Group of Individual Drive in Certain Installations, by Mr. C. A. Graves, Edison Electric Illuminating Company of Brooklyn; New York High-Pressure Water System, by Mr. Arthur Williams; Relation of the Electric Vehicle to Central Stations, by Mr. J. T. Hutchings, Rochester Railway & Light Company; Adoption of Electric Heat for Industrial Purposes, Mr. Charles J. Russell, Editor, Philadelphia Electric Company.

Third Session, Friday, 10 a. m.

Electricity for National Advertising, by Mr. George Williams, Henry L. Doherty & Company; Isolated Plants, Mr. R. S. Orr, Editor, Allegheny County Light Company; Central-Station Operation of Steam Plants in Connection with Central-Station Service, by Mr. S. M. Bushnell, Commonwealth Edison Company; Novel Methods of Advertising in Small Towns, Mr. Alex. J. Campbell, Editor, New London Gas & Electric Company; Development of Revenue from Existing Customers, by Mr. T. I. Jones, United Electric Light & Power Company; Electricity for Domestic Purposes, Mr. M. E. Turner, Editor, Cleveland Electric Illuminating Company; The Effect of Various Conditions of Maintenance on the Efficiency of Illumination, by Mr. A. L. Eustice, Nernst Lamp Company.

ACCOUNTING SESSION.

Friday Morning.

Depreciation, by Mr. G. E. Claflin; Payrolls, by Mr. W. W. Freeman, Brooklyn, N. Y.; Cost Accounting, by Mr. H. R. Kern, Philadelphia, Pa.; Supplies, by Mr. E. A. Baily, Brooklyn, N. Y.; Branch Offices, by Mr. E. J. Allegaert, Brooklyn, N. Y.; Memorials, by Mr. T. Commerford Martin, New York.

PROGRAM OF ENTERTAINMENT.

Monday Evening.—Opening of the exhibition of the associate members, 8 o'clock p. m., Exhibition Hall, Million-Dollar Pier. Reception to delegates and guests by the president of the association and reception committee, 9 o'clock, in Exhibition Hall.

Tuesday Morning and Afternoon.—Informal sailing parties, boats leaving Inlet Pier every half hour, beginning 10 a. m.

Wednesday Morning.—Informal sailing parties, boats leaving Inlet Pier every half hour, beginning 10 a. m. *Afternoon.*—Baseball game, West versus East, at Inlet Baseball Park. Game commences at 3 o'clock; players on the two teams are selected from members of the association living in the East and in the West. The Western team is captained by Mr. Frank W. Frueauff, and the Eastern team is captained by Mr. Frank G. Vaughan.

Thursday Morning and Afternoon.—Informal sailing parties, boats leaving Inlet Pier every half hour, beginning 10 a. m. *Evening.*—At 8:30 o'clock, the thirty-second convention, Café Chantant, in Marine Hall, Million-Dollar Pier. A high-class vaudeville performance will be given, and refreshments served throughout the evening.

Friday Morning and Afternoon.—Informal sailing parties, boats leaving Inlet Pier every half hour, beginning 10 a. m.

Exhibits at the N. E. L. A. Convention.

From the standpoints of variety and completeness, the exhibits at the coming N. E. L. A. convention at Atlantic City promise to be the most interesting yet given in connection with that body. All the booths have been taken and the final details have been perfected so that the formal opening of the exhibition will take place on Monday evening, May 31, at 8 o'clock. The booths were completed and ready for exhibits on Wednesday and since then a representative of the exhibition committee has been stationed at the freight entrance of the Million-Dollar Pier to number and register every box and package as it enters the building. This will greatly facilitate location of packages temporarily misplaced. Direct current and 125-cycle, single-phase current are available on the pier for working exhibits, but flaming-arc and other high candle-power lamps will not be permitted to burn uninterruptedly in the exhibition hall, space being provided for this purpose on the side of the pier facing the Boardwalk. Uniform signs, booths, etc., will prevail as heretofore.

Important International Agreement on Photometric Units.

We have received from the National Physical Laboratory of Great Britain the following announcement relating to the establishment of an "international candle" photometric unit:

In order to determine as accurately as possible the relations between the photometric units of America, France, Germany and Great Britain, comparisons have been made at different times during the past few years between the unit of light maintained at the Bureau of Standards, Washington; at the Laboratoire Central d'Electricite, Paris; at the Physikalisch-Technische Reichsanstalt, Berlin, and at the National Physical Laboratory, London.

The unit of light at the Bureau of Standards has been maintained through the medium of a series of incandescent electric lamps, the values of which were originally intended to be in agreement with the British unit, being made 100/88 times the Hefner unit.

The unit of light at the Laboratoire Central is the bougie decimale, which is the twentieth part of the standard defined by the International Conference on Units of 1884, and which is taken, in accordance with the experiments of Violle, as 0.104 of the Carcel lamp.

The unit of light at the Physikalisch-Technische Reichsanstalt is that given by the Hefner lamp burning at normal barometric pressure (76 cm) in an atmosphere containing 8.8 liters of water vapor per cubic meter.

The unit of light at the National Physical Laboratory is that given by the 10-cp Harcourt pentane lamp burning at normal barometric pressure (76 cm) in an atmosphere containing 8 liters of water vapor per cubic meter.

In addition to the direct intercomparison of flame standards carried out recently by the national laboratories in Europe, one comparison was made in 1906 and two in 1908 between the American and European units by means of carefully seasoned carbon-filament electric standards, and as a result of all the comparisons the following relationships are established between the above units:

The pentane unit has the same value within the errors of experiment as the bougie decimale. It is 1.6 per cent less than the standard candle of the United States of America, and 11 per cent greater than the Hefner unit.

In order to come into agreement with Great Britain and France, the Bureau of Standards of America proposed to reduce its standard candle by 1.6 per cent provided that France and Great Britain would unite with America in maintaining the common value constant, and with the approval of other countries would call it the international candle. The National Physical Laboratory, London, and the Laboratoire Central d'Electricite, Paris, have agreed to adopt this proposal in respect to the photometric standardization which they undertake, and the date agreed upon for the adoption of the common unit and the change of unit in America was April 1, 1909. The following simple relations will therefore hold after that date:

Proposed new units = 1 pentane candle = 1 bougie decimale = 1 American candle = 1.11 Hefner unit = 0.104 Carcel unit. Therefore, 1 Hefner unit = 0.90 of the proposed new unit.

The pentane and other photometric standards in use in America will hereafter be standardized by the Bureau of Standards in terms of the new unit. This, within the limits of experimental error, will bring the photometric units for both gas and electrical industries in America and Great Britain and for the electrical industry in France to a single value, and the Hefner unit will be in the simple ratio of 9/10 to this international unit.

The proposal to call the common unit of light to be maintained jointly by the national standardizing laboratories of America, France and Great Britain the "International candle" has been submitted to the International Electrotechnical Commission, and through it to all the countries of the world which are represented on that commission.

The above agreement has received the approval of the British Gas Referees and the standards of the National Physical Laboratory are being maintained in accordance with it.

After the above matter was in type the Bureau of Standards issued a circular dated May 20, in which similar announcement is made of the agreement relative to the unit of light. In addition, the circular of the bureau gives the following account of the history of the new unit and the bearing of its adoption on the electrical and gas interests:

The above announcement marks an important step forward in the history of photometric measurements. For many years the British Parliamentary candle was the unit recognized in this country, but the lack of precision in practical photometry did not permit its value to be very accurately expressed or reproduced. In recent years the gas industry has employed the 1-cp sperm candle, the 10-cp Harcourt pentane lamp, the Hefner lamp and various secondary standards, while the electrical industry has employed incandescent electric lamps either certified by the Bureau of Standards or rated in terms of standards that are consistent with those of the bureau. The unit of the bureau has been maintained very constant, as shown by frequent comparisons with the standards of France, Germany and Great Britain, but differed appreciably from the British unit and hence from the unit employed by most of the gas companies in America.

The Bureau of Standards took the initiative several years ago in bringing about international uniformity in the unit of light by sending its representatives abroad with copies of its standards to determine more accurately the relative values of the units of the several European countries and to urge the adoption of an international unit. In this country the American Institute of Electrical Engineers, the American Gas Institute and the Illuminating Engineering Society have acted together in support of the movement, and have voted in advance to recognize the new unit of candle-power.

In England the National Physical Laboratory has secured the indorsement of the London Gas Referees and the Institution of Gas Engineers.

The union of the three national standardizing institutions of America, France and Great Britain in maintaining a common unit of candle-power, and the co-operation of the German Reichsanstalt in redetermining, from time to time, the ratio of the Hefner unit to the common international candle, assures the highest attainable constancy for the new unit of light.

Unfortunately there is no primary photometric standard that is sufficiently constant and reproducible to be generally accepted as an international standard. France, Germany and Great Britain each have their own primary flame standard, and a great deal of effort has been expended in attempting to determine accurately the relations between them. Until the flame standards themselves are better understood, however, and the atmospheric and other conditions more perfectly controlled, the

unit of light cannot be preserved as accurately by primary-flame standards as by incandescent electric secondary standards. The latter, when well made, properly seasoned and carefully measured, permit comparisons to be made (using the means of many settings on several lamps) with excellent precision, the lamps themselves being constant enough and the precision of measurement high enough to fix the final values to about one-tenth or two-tenths of 1 per cent. There is good reason to believe that in this way the international unit of light can be preserved so nearly constant that any inevitable drift occurring one way or the other would be too small to detect with certainty by any of our present flame standards in many years. The Bureau of Standards will continue to standardize flame standards by the electric standards and will also carefully investigate the flame standards. Similar tests and investigations will also be made in Europe, and if any appreciable drift does occur it will sooner or later be detected.

Careful distinction should be made in this connection between a *unit* and a *standard*. An international unit maintained by the co-operative effort of several national standardizing institutions, and checked from time to time by means of all the best primary standards in use, is more likely to be maintained constant than if it were defined to be represented by any single primary standard, unless such a primary standard were reproducible to a very high degree of precision. Such a *unit* can be continued permanent even though all present primary *standards* are ultimately superseded by better ones. The Hefner lamp as a convenient flame *standard* will not be displaced in America or any other country which adopts the international candle as its unit of light. Uniformity among different countries and continuity of value are prime necessities with respect to the *unit*. But the particular standard by which the unit is realized in practice is largely a matter of convenience and circumstance. In photometry of electric lamps electric standards are most suitable. In gas photometry one form of flame standard or another will be employed according to circumstances. It is not expected that all countries of the world will at once adopt the proposed international candle as their unit of light. Those countries which already have the Hefner unit in general use may prefer to continue it. But if all countries which have a unit differing appreciably from the Hefner shall adopt the international candle as their unit, there will then be only two units in use throughout the world, and they will have the simple ratio 9:10. This would result in a distinct gain both in the practice of photometry and in definitions and nomenclature.

The effect of this change of 1.6 per cent in the unit of the bureau, which is in general use for electric lighting throughout the country, is to raise the candle-power rating and decrease slightly the watts-per-candle of electric lamps. A 16-cp lamp will give 16.26 candles in the new unit, or a 16-cp carbon-filament lamp burning at 110 volts will give 16 candles on the new basis at 109.69 volts. The change, though small, is important in the photometry and rating of lamps.

The new unit of candle-power being in agreement with the present English unit as represented by a 10-cp standard pentane lamp, there will be no change in the unit of light now employed by those gas companies which use pentane lamps, provided they are in agreement with the English standard. But as pentane lamps may differ slightly from one another, even when burned under the same conditions, it is desirable for the sake of greater uniformity to have them standardized in terms of the standard candle of the bureau. These variations, amounting to from 1 to 5 per cent, are generally in the same direction; that is, the lamps if not correct usually give less than 10 international candles under standard conditions when burning in a pure atmosphere at a normal barometric pressure of 76 cm of mercury and an atmospheric humidity of 8 liters of water vapor per cubic meter. In anticipation of this change some of the largest gas companies in the United States have already had their pentane and Hefner standard lamps standardized by the bureau in terms of the new unit.

Gas standards will hereafter be certified in terms of the international candle. Electric standards will be certified in terms of the old unit until July 1, 1909, unless otherwise requested. On July 1 the new unit will be adopted by the Bureau of Standards in the certification of electric standards, and it is hoped that manufacturers of electric lamps will adopt the new unit as soon thereafter as possible.

The bureau recommends that all gas and electric companies, all photometric laboratories and all the manufacturers of electric lamps in the United States adopt the new unit of candle-power, if possible, not later than Jan. 1, 1910. Further information with regard to change of photometric unit or to the testing of gas and electric standards will be given by the bureau on request.

We understand that several countries have joined the United States, England and France in adhesion to the new unit, and that favorable action from a number of others is expected in the near future.

Western Union Wins Long-Standing Suit Against Bell Company.

After litigation extending over a period of 26 years the Western Union Telegraph Company has won a suit for damages from the Bell Telephone organization, involving an award estimated at approximately $6,000,000 on account of shares of stock received by the defendant in connection with telephone rentals and royalties paid by the plaintiff. The suit was brought to require the defendant to account for shares of stock which it is alleged by the plaintiff were within the covenant by the defendant to account for 20 per cent of all rentals or royalties received from licenses or leases for speaking telephones, upon the ground that these stocks were received as rentals for such licenses. An appraisal of the stocks for which the suit was brought will shortly be filed, with the report of the master, Everett W. Burdett, Esq., of Boston, in the United States District Court. The Western Union company sought about $10,000,000 in this action, but there have been large reductions in the claims.

The present master was appointed in 1904 on the decree of the Circuit Court of Appeals remanding the case to the United States Circuit Court to enter a decree for the plaintiff for an accounting and further proceedings. The plaintiff proved by June, 1905, that the telephone company had received up to Nov. 1, 1904, stocks to the par value of $17,735,364 for licenses to rent and use telephones, and had received as dividends $13,692,-114, and that the interest on the dividends amounted to $7,340,726, making at the par value of the stocks $38,768,205, and had also received for licenses to use and rent telephones $167,790 in cash, and as interest thereon $129,008, making in all $39,065,003, for 20 per cent of which it was accountable to the plaintiff if the stocks were to be taken at their par value. The parties to the suit are the Western Union, the American Speaking Telephone Company, the Gold & Stock Telegraph Company, the Harmonic Telegraph Company, American Bell Telephone Company and the American Telephone & Telegraph Company, successor.

In discussing the decision, Mr. George V. Leverett, general counsel of the American Telephone & Telegraph Company, said that the report does not, in its present form, attempt to give the account, but simply outlines the principle by which the master expects to be guided in stating the account in figures. "The master has followed the rules laid down for him in the Circuit Court of Appeals, but in developing the account has allowed substantial deductions claimed by the telephone company. The whole principle of the accounting, as interpreted by the master, is disputed by the defendant, and when the accounting has been completed the defendant company still will claim that it is not liable under the contract.

"The present status of the case is that both parties will file suggestions, in the light of which the master will, if he shall see fit, revise his report. A formal report will later be filed in the Circuit Court and the parties will then take their exceptions to the report, which will be argued before the court itself."

When the filing of the report is completed, which may be

within a fortnight, the case will be argued before the United States Circuit Court in Boston and then may go higher to the United States Circuit Court of Appeals and finally to the United States Supreme Court.

Officers of the Western Union expressed gratification at the outcome of the suit, which has been pending since 1879. While the $6,000,000, it was said, would be fairly satisfactory, several details are yet to be passed upon and their adjudication may result in an additional amount. "We are glad the suit is settled," said Col. Robert C. Clowry, president and general manager of the Western Union, yesterday. "We sued for more than the $6,000,000, but shall be fairly content with the award."

Important Telephone Decision.

On May 20 Judge R. W. Taylor, of the United States District Court for Northern Ohio, sitting at Toledo, refused to grant the petition of the United States Telephone Company that a temporary restraining order issued against the Central Union Telephone Company and the American Telephone & Telegraph Company, denying them the right to connect with Independent exchanges, be made permanent. In asking this action of the court the United States Telephone Company took the ground that it already had 99-year contracts with most of the Independent companies in Ohio, although seven or eight of them had so far broken the contracts as to connect with the Bell system. It was further alleged that the Bell companies were endeavoring to form a monopoly and finally secure control of all the Independent business.

Judge Taylor held that the court did not have jurisdiction to decide the matter in reference to the local Independent companies which were not represented, and that no such relief as sought through this action could be granted without their presence. The effect of sustaining the bill filed by the United States Telephone Company, he said, would be to order a specific performance of the exclusive contract with this company, to the effect that the local companies may not make connection with any other long-distance company for 99 years. This is sought without asking the other party whether it consents to have a decree against it which shall fix its contract rights with the complainant and the defendants.

Regarding alleged violation of the Sherman anti-trust act, the court said that the United States Telephone Company is proceeding in that manner instead of the defendants. The contract, he says, is contrary to common law and void and it is in violation of the common law and the statutes of the State of Ohio requiring equality and impartiality of service to all persons similarly situated. It would be against the rules of equity and public policy for a local telephone company to make a contract that would give one company the long-distance business of its patrons exclusively. By making such a contract it disables itself from entering into any other arrangement to furnish its patrons long-distance service or competition in that branch of service.

Attorneys for the complainant company argued that the charter of the local companies does not require them to furnish long-distance service and that it is a common carrier within the limits of its own exchange, its own lines and among its own patrons. If it extends its service beyond local use, when not so required, it is violating no provision of the statute if it gives to a long-distance company the exclusive right to make connections with the exchange, as it only disables itself from doing that which by law it was not required to do at all. It was also argued that through the power to consolidate with other companies or lease its properties to another company, a local company has more complete authority to annihilate itself than is shown in the exclusive contract with the long-distance company. The court held, however, that the consolidation or the leasing company, as the case might be, would be compelled to perform the same service as the original company and in every way would take its place. It would have no more authority or power to disable itself by giving an exclusive right to long-distance business to any one company that its predecessor had.

Referring to the case cited of the Chicago, St. Louis & New Orleans Railroad Company vs. Pullman Company, in which it was held that a 15-year exclusive contract was valid, the court said that the telephone is different in that it is not claimed that either of the companies is able to furnish connections with all the places with which subscribers may wish to talk. A sleeping-car company may furnish adequate and comfortable service over a certain line of railroad, but the telephone company cannot furnish it all over the country. Several other reasons were given to show that the kind of service in the two cases is different. The argument that telephone companies have no more right to force connections upon each other than railroads is treated quite at length, but there again the court holds is a difference.

The court said that when a company came into a community offering to give the people long-distance service and connection with the rest of the world, public policy will say that it shall be treated no differently from the individual who requests telephone connection with the exchange on terms to which he is entitled.

Independent local companies do not make long-distance companies any the less public by extending their connections to the latter, nor do they become any less local and independent by permitting connection with long-distance companies. If they have granted connection to one long-distance company, it would certainly seem that under either the statutes or common law the same right should be given other companies that desire them. Courts have had great difficulty in escaping the claim that local companies must be compelled to permit their exchanges to be connected and where they have once been connected, the decisions are to the effect that they cannot be disconnected.

The court discussed the subject of discrimination as practiced among telephone companies and quoted the following syllabus from another case of a similar nature: "Where an operator of a telephone system furnished connected immediate service to separate exchanges and their patrons, but denied such service to another exchange and its patrons of the same class, the operator discriminated against the latter in violation of the common law and of the statute of Indiana, requiring telephone companies to supply applicants impartially."

The court said: "I find myself profoundly impressed with the soundness of the conclusion just quoted and, indeed, I can conceive of no plausible argument against it. The telephone company is a public servant and is a common carrier of news, as the Indiana Supreme Court puts it. It cannot enter into a contract which tends to create a monopoly; and it cannot deny to one person the rights and privileges which it grants to other persons similarly situated. The contract in question does tend to create a monopoly, in that it refuses to the subscribers to the local company any opportunity through the local exchange for competitive service; and the local company ceases to be a common carrier, devoted to a public use, offering the same terms, opportunities and privileges to all persons similarly situated, in that it undertakes to give to the complainant what it denies to the defendant.

"The position which counsel for the complainant take comes to this when we analyze it: The Bell Telephone Company is a wicked monopoly. Some years ago the United States Company concluded to fight it. The only way to fight the devil was with fire. The only way to fight the monopoly was to monopolize all unoccupied territory. The way to monopolize this unoccupied territory was to go to a local telephone which had no long-distance connection and offer to give it such long-distance connection, provided a perpetual monopoly of it was given in return.

"This purpose to destroy the Bell monopoly may be admitted to be virtuous. The method resorted to was vicious. It was a mere repetition and imitation of the methods which, when followed by the Bell company, are so bitterly denounced. The philosophy that the end justifies the means, when the end is

virtuous and the means vicious, has long since been discarded, if it ever had any avowed supporters. But even that philosophy cannot apply to a mere business undertaking. The purpose to destroy the telephone monopoly was not a virtuous purpose; it was a business proposition which incidentally led, we may assume, to a righteous result. What becomes of the righteous result when the means to accomplish it are the means of unrighteousness?—the ultimate result of which may be that we discover we have exchanged one master for another, or if not, that we have emphasized the strength of the former master. Counsel, of course, will not deny that if the Bell company should acquire control of the complainant, these contracts would be just as valid and the shield of our defense would be turned into a weapon with which to destroy us."

On Saturday the directors of the United States Telephone Company and representatives of the Ohio Independent Telephone Company met at the general offices in Cleveland and decided to bring suits against all local companies that violate their contracts in the State courts, since the decision of the Federal Court is that it has no jurisdiction in the matter of contracts with the local companies because they were not made parties to the suit. In two out of three cases already brought in the State courts the decisions have been in favor of the Independents and the contract has been held valid. All suits will hereafter be brought in the counties where contracts are violated. However, the leaders of the Independent movement believe that few of the local companies will violate their contracts with the United States Telephone Company, because of their loyalty to the cause they have been championing.

Another interesting feature is that under the decision of Judge Taylor, any long-distance company has a right to demand connection with the exchange of a company which has granted that privilege to any other company and upon equal terms. This opens up all Bell territory to the Independents, as well as Independent territory to the Bell interests. An exchange with long-distance service cannot refuse a second or third connection. Whether the companies will make use of this privilege remains to be seen. It will either act as a bar to both companies or a means of fierce competition.

Electric Railway School of Practice.

The Metropolitan Street Railway Company, of New York City, has announced the organization of a school for the practical training of technical employees. The expenses of the school will be defrayed by the company, and it will be open to college and scientific school graduates. The pupils will be paid living wages while taking the two-year course.

The difficulty of obtaining high-class men who are willing to begin at the bottom and learn the street-railway business was what led Mr. Oren Root, Jr., general manager of the Metropolitan, to work out the school plan and resolve to try the experiment, which was approved by the receivers of the company. A prospectus of the school and application blanks have been sent to the presidents of 19 colleges and scientific schools, with the request that the plan be brought to the attention of those students to whom it might appeal.

The schools and colleges from which Mr. Root expects to recruit the majority of his pupils are as follows: Amherst College, Brown University, Cornell University, Cambridge Manual Training School, Dartmouth College, Hamilton College, Massachusetts Institute of Technology, Purdue University, Brooklyn Polytechnic Institute, Pratt Institute, Rensselaer Polytechnic Institute, Stevens Institute of Technology, Syracuse University, Tufts College, Union College, Wesleyan University, Sheffield Scientific School, Worcester Polytechnic Institute and Williams College.

Mr. Root said it was his intention to establish a practical training school for young men, particularly graduates of high schools, manual training schools, colleges or universities, who have had more or less technical training and who intend to enter upon the vocation of operating street railroads. It is the aim to make the conditions advantageous to the young man who has an inclination to enter upon work of this character.

Such a man, under the proposed plan, will have an opportunity to acquaint himself with the details of the work, while receiving at the same time a salary which will, with strict economy, enable him to be self-supporting. He may thus determine for himself whether he is fitted and has a liking for employment of this character. On the other hand, the Metropolitan Street Railway Company will profit by the experiment in that it will be possible to test the capacity, ability and adaptability of applicants, who will constitute a body of candidates from whom men may be chosen when it becomes necessary to fill vacancies in the regular operating staff.

The course will be two years. During the first year the student will be paid $15 a week. The second-year man will receive $20 a week. To give him a general idea of the street-railway business he will be assigned to duty in the maintenance of way, the electrical, the equipment and the transportation departments, spending three months in each department.

In the maintenance of way department the student will do field work in connection with renewal of rails, installing tracks, surveying, etc., and will study designing and construction of buildings, efficient and economical handling of men, laying of pavements, fireproof car-house construction, time keeping, etc. In the electrical department he will familiarize himself with the conduit and feeder system, the location and character of the cables by which power is transmitted from the power station to the cars on the streets, electrical and steam engineering, etc.

While in the equipment department the student will be assigned to work in the car barns and repair shops. He will study maintenance of car equipment under operating conditions, rewinding of armatures, repairing of commutators, blacksmithing, lathe turning and metal work in general.

In the transportation department he will learn to operate a car and will become thoroughly familiar with all its mechanism. He will act as conductor and motorman for a short period. Then he will have a thorough course in the details of regulating the service under normal emergency conditions. He will also learn routine work in the division offices, such as time keeping, checking up the cash received from conductors, making up of accident and other reports, etc.

Mr. Root calls attention to the fact that the work is hard, as the street cars of New York City are operated 24 hours a day throughout the entire year, including Sundays and holidays, and adds that only men physically strong and capable of hard work and long hours ought to apply for admission to the training school. Any man who feels that he can fill the requirements and who desires to enter upon such an apprenticeship may file his application with Mr. F. T. Wood, assistant to the general manager for receivers, Metropolitan Street Railway Company, 621 Broadway. The application should be filed in person before June 15, or between July 1 and July 15 of the current year. Application blanks will be forwarded upon request.

Annual Meeting of National Electrical Trades Association.

The annual meeting of the National Electrical Trades Association will be begun at the Exchange Club, Boston, at 10 a. m. on June 21. This association comprises local associations in five different cities of the United States and has a total membership of 450 electrical manufacturers and jobbers. The official delegates to the annual meeting will consist of one representative from each of these cities, together with Mr. Frederic P. Vose, of Chicago, the general secretary. These delegates are: Philadelphia, Mr. Charles M. Wilkins, of Partrick, Carter & Wilkins; Boston, Mr. Norman Marshall, of the Marshall Electric Company; New York, Mr. John F. Dale, of the Dale Company; Chicago, Mr. James Wolff, of the New York Insulated Wire Company; San Francisco, Mr. C. C. Hillis, Electric Appliance Company. Mr. Wilkins is president of the national association and Mr. Marshall is vice-president. In addition to the official delegates it is believed that there will be a record-breaking attendance of members of the association.

Tesla Propulsion Company.

The Tesla Propulsion Company, with $1,000,000 capital stock, has been incorporated at Albany, N. Y. The directors include Mr. Nikola Tesla, Mr. Jos. Hoadley and Mr. Walter H. Knight. Mr. Tesla said the company will manufacture apparatus constructed on a mechanical principle of his discovery, entirely new, and of the greatest economical value, the details of which he will make known in about six weeks. The principle, he says, minimizes the size of a power producing plant and increases to a maximum the power produced. A plant now being built for the Alabama Consolidated Coal & Iron Company will not be one-third of the size of the ordinary equipment for its work, while the air blast which it will include and other details will have a far superior value. In connection with this plant Mr. Tesla said he would install a turbine of his own invention, and that the air blast will be supplied under the turbine principle. The new mechanical principle involved is applicable to air, steam, gas and water-power, and may be used for locomotives, automobiles or any power application. With it a locomotive as powerful as any now used need not be half the present size.

Hydro-Electric System of Southern Power Company.

The Southern Power Company, Charlotte, N. C., has now in service three of its chain of hydro-electric stations, aggregating 60,000 kw—the Catawba, Great Falls and Rocky Creek plants. An 18,000-kw station at Ninety-Nine Island is well under way, and preliminary specifications have been issued for the machinery of a 147,000-kw station at Wateree. The equipment of the latter will consist of 14,000-hp, horizontal twin turbine units, and 8500-kw, 11,000-volt, 180 r.p.m. generator units having a power factor of 85 per cent. In addition there will be four units made up of 3000-kw generators coupled to 5200-hp vertical twin turbines.

The Catawba plant of the Southern Power Company was completed in 1904, and the second or Great Falls plant in 1905. There remain several undeveloped powers aggregating 50,000 kw, so that the system will eventually comprise 250,000 kw.

Of the lines now in service, over 400 miles are operated at 50,000 volt, steel towers being used over about 200 miles. Fifty-eight miles of line is operated at 11,000 volts. One-hundred-thousand-volt twin steel tower lines aggregating 260 miles are being built, of which 116 miles are nearly completed and all will be ready for operation by Sept. 1. One-hundred-thousand-volt transformers, having a capacity of 120,000 kw, have been purchased for this latter distribution.

At present 46 substations supply power from 11,000-volt and 50,000-volt lines to over 100 cotton mills, the mill load being 80 per cent of the total. Twelve 100,000-volt stations are being built, two of which are about completed. Mr. W. S. Lee is chief engineer, and Mr. J. W. Frazer assistant chief engineer.

Chicago Electric Club and the University of Illinois.

At the meeting of the Electric Club, of Chicago, on May 19, Mr. F. P. Vose occupied the chair in the absence of President Howlett. The speaker after luncheon was Dr. David Kinley, professor of economics and dean of the graduate school at the University of Illinois, who made a bright speech relating to the work and needs of that university. He enlivened his remarks by several stories, and one of them that evoked applause related to a conversation overheard between two men who were leaving a lecture. One asked the other how he liked the address, and the answer was that it was illuminating in an old-fashioned way. The first speaker inquired what that meant, and the other replied that the speech had more gas in it than electricity. Dr. Kinley hoped that a similar criticism could not be applied to his address.

The University of Illinois, the speaker said, is a modern university with modern ideas. He described the work of the various colleges and made more extended reference to the activities of the Engineering Experiment Station, which has proved of great value and has received a great many requests from manufacturers to solve particular industrial problems. Dr. Kinley also referred to the School of Commerce, which is in his immediate charge. Here the principles of business administration are taught, and many of the graduates of the school are doing well in practical business life. Turning to the needs of the university, the speaker said that more than 30 members of the faculty have been called to other positions within the last two years. To retain men of a high grade it is necessary to pay salaries commensurate with those which obtain in business and professional pursuits outside the university. That explains why the university is asking the Legislature for an appropriation of $25,000 to increase salaries.

At the conclusion of Dr. Kinley's talk Mr. W. S. Taussig spoke briefly, and he was followed by Mr. W. L. Abbott, who offered a resolution to the effect that the club "indorse the request of the University of Illinois for a reasonable increase in appropriations for general operating expenses, for the Engineering Experiment Station and for increasing salaries of important positions." This resolution was promptly seconded and was adopted without a dissenting voice.

New York Public Service Commission News.

In the investigation by the Public Service Commission of the First District of New York into the affairs of electric light and power companies, held last week, Messrs. C. F. Matthewson and C. D. M. Thomas, of the New York & Queens Electric Light & Power Company, give the details of the various grants and franchises under which their company operated in that section of Greater New York which was formerly embraced in the villages of Jamaica, Richmond Hill, Flushing, College Point and Whitestone. The company derived its rights from grants that had been given to a number of local companies, all of which have been subsequently bought up and consolidated. These privileges for the most part were awarded by boards of supervisors and highway commissioners. In almost all of these grants the contract for public lighting embraced the feature that one free light should be furnished for every 10 lights that were paid for. Mr. Matthewson testified that in most instances this provision was still in force and the city was deriving the benefits therefrom. It was shown that the first franchise that was granted in the village of Flushing, in 1899, was issued to the Flushing Electric Light & Power Company and was considered at that time to be merely experimental. The purpose of the franchise was "to afford the residents of the village an opportunity of testing the value of the system of electric light and power."

The Public Service Commission has granted the application of the receivers of the Metropolitan Street Railway Company for a rehearing on the order recently adopted requiring the company to install wheel guards on its cars. The company stated that it is now experimenting in various types of wheel guards and that it would give the result of these experiments at the rehearing.

It was announced at a public hearing before the Public Service Commission last week that the subway loop which is to connect the Manhattan terminals of the three East River bridges is practically completed and ready for the tracks except that portion at the end of the Brooklyn Bridge which will be under the foundations of the new municipal building. As the plans for this building are not yet perfected, the new subway is likely to remain idle for some time.

Governor Hughes, of New York, heard arguments on May 22 upon the Travis-Robinson rapid transit bill which repeals the Elsberg law and permits the construction of rapid transit lines with private capital. As the bill was drawn with Governor Hughes' approval it is not likely that it will be vetoed.

The Wireless Institute.

No. 2 of Vol. 1 of the *Proceedings* of the Wireless Institute contains a paper presented at the May meeting of the body by Mr. Greenleaf W. Pickard entitled "Antennæ." The subject is treated both historically and technically. To Professor Dolbear is assigned priority in the use of the wireless antenna in connection with hertzian radiations. In the discussion data as to range of wireless working are given.

The officers of the Wireless Institute are as follows: President, Mr. Robert H. Marriott, Brooklyn; vice-presidents, Messrs. Harry Shoemaker, Jersey City, and Greenleaf W. Pickard, Amesbury, Mass.; directors, Messrs. John S. Murphy and Richard A. Somerville, New York; treasurer, Mr. Eugene M. Thurston, New York; secretary, Mr. Sidney L. Williams, 42 Broadway, New York.

Convention of Society for Promotion of Engineering Education.

The seventeenth annual convention of the Society for the Promotion of Engineering Education will be held at Columbia University and Pratt Institute, in New York and Brooklyn, on June 24, 25 and 26. These dates immediately precede those of the meetings of the American Institute of Electrical Engineers, the Society for Testing Materials and the American Society of Civil Engineers, and New York City is very near the geographical center of the meeting places of three other societies. It will, therefore, be a convenient place of meeting for all who wish to attend the convention of one of the other societies.

The program of the meeting, besides a number of papers, will include a report of the Joint Committee of Engineering Societies on Engineering Education, by Prof. Dugald C. Jackson; a report of the Committee on Technical Books for Libraries, by Prof. Arthur H. Ford; a report of the Committee on Engineering Degrees, by Prof. William F. M. Goss; a report of the Committee on Entrance Requirements, by Prof. Robert Fletcher. In addition a special session will be devoted to the discussion of engineering mathematics by a Committee of Fifteen appointed at the Chicago meeting of the American Association for the Advancement of Science, which was requested to prepare a special report for the Society for the Promotion of Engineering Education for its meeting in 1909.

Massachusetts Legislative Notes.

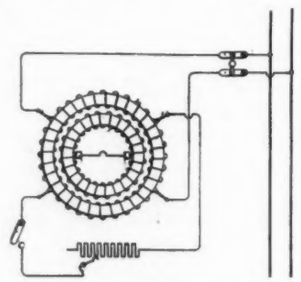
The Committee on Public Lighting has issued a favorable report on the petition of the Association of Massachusetts Gas Companies for legislation to permit gas companies and gas and electric light companies to adopt a sliding scale and to adjust capital to the value of property employed in business. A bill has been introduced into the Senate as a result of this action providing the terms under which the sliding scale may be adopted. Any gas company desiring to adopt the sliding scale is required upon the vote of its directors to petition the board of Gas and Electric Light Commissioners for a valuation of its plant and property, the company paying for all the expenses of the appraisal. The board is to determine the actual value of the real and personal property of the company, but without increase on account of the value of location, earning capacity, franchise, or good will; from the value so determined is to be deducted any indebtedness of the company and the remainder regarded as the net value of the plant and property for the purposes of the adoption of the sliding scale. The proposed law contains provisions for the approval of the plan by the commission, and for the issuance of new stock under certain restrictions. The standard rate of dividends for any company accepting the provisions of the act is 6 per cent per annum, and the standard price of gas $1 per 1000 cu. ft. Any company charging more than $1, and which desires to adopt the provisions of the act, may start with such a price with a reduction of 1 per cent in dividends for each 5 cents of price in excess of $1. If in any year the maximum net price charged by the company has been less than the standard price fixed by the company, it may declare dividends exceeding the standard rate in the ratio of one-fifth of 1 per cent for every 1 cent of reduction of the maximum net price below the standard, and a similar provision applies to the reduction of dividends where the net price has exceeded the standard price. The acceptance of the act holds for 15 years, but the commission has authority to change the price on appeal of the municipal authorities. Any company accepting the act is allowed, after making such an allowance for depreciation as the commission may deem reasonable, to accumulate an emergency fund not in excess of 10 per cent of its capital stock in the aggregate. This fund is to be invested and used in a manner to be decided by the commission, and the annual returns to the board are to show the amount charged off to depreciation and the emergency fund.

The same committee has reported a bill to enable gas and electric light companies to issue additional capital stock at a price not less than par as fixed by the stockholders and subject to the approval of the Gas and Electric Light Commission, in a manner similar to the authorization of electric railway stock issues under the supervision of the Railroad Commission. This action, if passed, will both enlarge the powers of the Gas and Electric Light Commission and enable central station and gas companies to issue new shares of stock with a little less rigidity as to price.

Braking Action of Repulsion Motor.

A peculiar interaction between electric and magnetic circuits is described in a U. S. patent recently issued to Mr. Maurice Milch. The performance is that of a repulsion motor when disconnected from the supply system and short-circuited upon itself without any interconnection between the rotating and stationary parts.

The machine is provided with two sets of primary terminals, one for clockwise rotation and the other for counter-clockwise rotation. If, when the machine is operating as a repulsion motor, revolving in, say, a clock-wise direction, the active primary leads are disconnected from the supply system and the other leads are short-circuited upon themselves, the residual magnetism in the core will produce in the rotor winding a current which will react upon the short-circuited stator winding and upon the magnetism of the motor in such a manner that the magnetism and the currents in both short-circuited members



MILCH BRAKING SCHEME.

will be increased. The effect is cumulative and large currents will be almost instantaneously produced, resulting in a strong braking action. In practice this cumulative effect is too sudden and produces too severe a shock upon the motor and the car if both the primary and the secondary windings are directly short-circuited. In order to reduce the shock a variable impedance is inserted in one of the circuits, as shown in the accompanying illustration. By short-circuiting the primary member through the whole of this impedance at first and then gradually reducing the amount of impedance included in the short-circuit as the motors slow down the braking effect may be readily controlled.

A Reminiscence of the Morse Telegraph.

In his autobiography, "Lights and Shadows of a Long Episcopate," the late Rt. Rev. Henry B. Whipple, Bishop of Minnesota, quotes an interesting visit made by him to the room in the Capitol at Washington where in 1844 Mr. S. F. B. Morse was experimenting with the telegraph. Speaking of the practicability of making a rapid journey between Albany and Utica in another connection, Bishop Whipple says: "This seemed no less a flight of the imagination than did that of a statement made to me upon my first visit to Washington, in 1844. After visiting the places of interest in the city I went to the Capitol to say good-by to a friend who was a member of Congress. As I was leaving the room he said: 'By the way, the sergeant-at-arms has given a room in the basement to a man who claims that he can send a message by wire in less than a minute. I do not believe in it. It is probably one of the many schemes to get an appropriation from Congress. But it may amuse you to see it.'"

Bishop Whipple continues: "I went to the basement and found a tall, thoughtful-faced man who received me courteously, and in answer to my queries said, with a smile: 'There is no possible deception. I can convince you in one minute of the value of this invention. You see that battery? It is connected with a wire the other end of which is near the Relay House. I will send the message, "Mr. Whipple of New York is here." In a moment the answer came back. It was before the day of reading by sound, and the alphabet consisted of a series of dashes on a coil of paper. Mr. Morse—for it was he—tore off a slip of paper, and making the alphabet on another slip, said: 'You must read this. What is the first letter?' 'T,' I answered; and on, on, until I was able to read the message: "Tell Mr. Whipple that he is looking upon an invention which will revolutionize the commerce of the world.'"

The point of the story is somewhat blunted by the fact that the electric telegraph had been in commercial use in Europe as early as 1837.

Physiological Effects of Illumination.

At the Boston meeting of the Illuminating Engineering Society, held May 12, Prof. Sidney W. Ashe presented a paper entitled "Physiological Effects of Illumination," which gave some of the results of research by the author at Columbia University. The paper relates more particularly to the reaction of the pupil of the eye to color. Among the subjects treated are the functions of the pupil, its reaction to light stimulus, visual -acuity, pupillary reaction, physical errors, physiological errors, use of mydriatics and myotics. Following are the conclusions of the paper:

1. In measuring the diameter of the pupil great care must be taken to choose the same average value each time, as the pupil keeps changing continually.

2. The use of mydriatics, myotics and all forms of diaphragms should not be used in studying visual acuity or the contraction of the pupil, as they change the normal action of accommodation of the eye.

3. The readings of light intensity or luminosity should be taken with a flicker photometer where a difference of color exists and each observer should use his own values of luminosity, owing to a difference of appreciation in each individual.

4. Lights should be carefully standardized and where fine spectral colors are used, a glass with a carbon bisulphide prism mounted in connection with a pair of condensing lenses will give pure spectral colors, whose wave lengths and luminosity may be readily determined with the spectro flicker photometer method.

5. Under these conditions the writer has found that for equal luminosities there is a difference in the size of the pupil for different colors arranging themselves in the order red, white, green, etc.

6. As the quantity of light which would enter the eye varies as the square of the diameter of the pupil, a small change in diameter makes a large change in intensity.

In the discussion, Mr. Preston S. Millar criticized the accuracy of the flicker photometer, while in the determination of the relative intensity of different colored lights different observers will with it agree better; this proves only that it is a simple instrument for use in that kind of work. It remains to be demonstrated if the flicker photometer yields satisfactory results on differently colored lights. Dr. Williams described the use of the simple photometric wedge in measuring the difference in intensity of electric lights. The wedge film is moved across the field of vision until first one light is cut out and then the other. An apparatus was discussed for the practical application of this method.

Southwestern Electrical & Gas Association Convention.

The Southwestern Electrical & Gas Association held its fifth annual convention at Dallas, Tex., May 21-22. The registration exceeded that of any previous meeting, more than 340 members and guests being in attendance. The first session opened with an address of welcome by a city official, and a response by Mr. Sam A. Hobson. After other introductory business, President R. R. Stichter, general manager of the Texas Traction Company, of Dallas, delivered his address, which dealt largely with matters of association policy, and included several recommendations which were referred to a committee. In its report later at the meeting, the committee expressed the opinion in reference to a suggestion for the appointment of committees on uniform city laws and on publicity that these subjects could best be handled by the appointment of an officer who would make a specialty of the work connected therewith. As to the appointment of two standardization committees, one on material and another on accounts, the committee was of the opinion that the only way to deal with work of this kind was to subdivide it among the different State and Territorial associations, who in turn would report their decisions to the National Association for action.

The program of the Dallas meeting included papers dealing with electric lighting, electric railway and gas subjects. In addition to the papers, of which abstracts are given below, one was presented by Mr. Thomas Cook entitled "Economies That Can Be Made in the Operation of a Small Central Station," of which an abstract will appear later.

Mr. W. B. Head presented a paper on "Producer-Gas Plants for Small Central Stations," which was strongly in favor of the use of such plants, particularly in Texas, where, with lignite coal, they have shown, it is stated, an enormous saving over steam plants. Several manufacturers of producer-gas plants are guaranteeing a fuel consumption of 2 lb. to 3 lb. of lignite per brake horse-power with 50 per cent load factor. The writer says that after a year's experience with a 100-hp unit he feels safe in saying that a first-class gas-producer plant is as reliable in every respect as a steam plant. A somewhat better class of labor is needed, however, to operate the former, but skill on the part of the attendant is not as necessary as carefulness. The cost of installation is about 40 per cent more than that of a steam-engine plant. In concluding he said that the successful use of lignite in the producer plant means much to Texas from an industrial standpoint.

Mr. Fred M. Lege, Jr., of Galveston, Tex., presented a paper entitled "Low-Pressure Turbines." In general, he said, it is safe to say that in large plants, comprising two or more reciprocating engines, the low-pressure steam turbine has a proper place, whereas in smaller plants having only one engine, and this in poor condition, it is generally better policy to install a complete high-pressure condensing turbine of the full power required, and hold the old engine as a reserve. While a high-pressure turbine will more economically utilize energy in steam than a reciprocating engine, when an increase is necessary to an existing reciprocating plant where good engines are in use, a low-pressure turbine can oftentimes be installed to better ad-

vantage than any other piece of apparatus, entailing no increase in the boiler plant or building proportionate to the increased capacity, and in many cases without any increase in space. This affords a means of increasing the capacity of an existing central-station equipment with respect to steam engines with but little increase of fuel used or additional boiler capacity. A combination of a low-pressure steam turbine and an existing reciprocating plant, the high-pressure engines exhausting into a suitable receiver and then into a low-pressure turbine, which in turn exhausts into a good condenser, affords as efficient a means of utilizing available energy of steam as can be desired. A low-pressure turbine requires something like 34 lb. of steam per kw-hour with a vacuum of 28 in. In the case of an existing plant operating compound and simple engines of 120-lb. pressure and exhausting into the atmosphere, by installing a low-pressure turbine an increase of approximately 100 per cent capacity is available, without any increased cost of fuel other than necessary for the auxiliaries, which would not exceed 15 per cent. In the case of compound-condensing units, and with a vacuum of 26 in., the addition of a low-pressure turbine will increase the capacity approximately 70 per cent and the combination will reduce the steam consumption per kw-hour from 22 lb. to 15.5 lb. of steam. The efficiency of a well-designed low-pressure turbine is remarkably uniform over a large range of load.

Prof. Arthur C. Scott, of the University of Texas, presented a paper entitled "Lamps for Residence Illumination," which dealt with the characteristics and comparative economy of operation of such lamps. The Nernst lamp and various types of incandescent lamps were described and illumination curves given for them; the Welsbach gas mantle was also considered. The paper included results of a life and photometric test of lamps made during the past year at the University of Texas by Mr. C. W. Conrad and Mr. W. W. McCullough. The lamps tested were carbon-filament, Gem, graphitized-filament, tantalum, tungsten, Nernst single-glower and reflex Welsbach gas lamps. The comparative costs per 1000 candle-hours were as follows:

Thirty-cp reflex Welsbach, horizontal-cp basis, 24.76 cents; 80-cp reflex Welsbach, on basis of mean candle-power between vertical and horizontal values in lower hemisphere, 21.08 cents; 60-watt tungsten lamps, 14.89 cents; 40-watt tantalum lamps, 26.42 cents; 50-watt Gem lamp, 32.87 cents; 110-volt, 16-cp carbon-filament lamps, 42.55 cents; Nernst 0.6-amp lamp, horizontal-cp basis, 26.44 cents; Nernst 0.6-amp lamp on basis of mean candle-power between vertical and horizontal values in lower hemisphere, 12.40 cents.

The Question Box was printed in advance and formed an interesting contribution to the proceedings of the convention. Below are given some of the answers which appeared to be of more general interest:

A station reported that the consumption of Texas fuel oil was 5 lb. per kw-hour at the switchboard. Two replies stated that there was no relation between the specific gravity and calorific values of ordinary fuel oils. A test was reported in which 14.84 lb. of water were evaporated by a pound of fuel oil having a calorific value of 17,241 lb.-Fahr. units, or 16.33 lb. with oil freed from all water. An inquiry as to what the price of lignite should be for it to prove more economical than good slack coal received the reply that lignite must be purchased at $1 or less per ton in the bin to prove as economical as good coal at $3 per ton. In reply to a query as to the overload capacity of steam turbines, it was stated that one type of these would carry enormous overloads far in excess of its guarantees, and that it was more efficient and reliable than a reciprocating engine. Of six answers in reply to a query as to whether it is advisable to use single-phase motors of 5 hp or less on polyphase circuits, four advised the use of single-phase motors of less than 5 hp, and one the use of single-phase up to 25 hp. A number of answers in reply to another query stated that single-phase motors are entirely satisfactory for operation on 60-cycle circuits. As to the location of lightning arresters, four replies were that they should be located outside the station, and the same number that they should be in the station, but not on the switchboard. One recommendation was that they should be mounted on a rack above the switchboard. Concerning the use of alternating-current motors for elevator service, three replies made to a query on the subject stated that they are not as well suited for general elevator work as direct-current motors. A difference of opinion developed as to the advisability of the use of the three-phase system for a service of 100 kw or less. One reply was this is practically impossible unless phase regulators were provided, and another that while it was possible it would be injudicious. Several replies were in the affirmative. In reply to a query as to the reduction in capacity when an alternator is changed from 133 cycles to 60 cycles, one reply was 40 per cent and another 45 per cent. Two rather remarkable opinions are among the number in reply to a query as to the tungsten lamp; one of these was that it is too frail for general use, and another that the tungsten lamp is not proving a success in the North! Two replies as to the average life of tungsten lamps were that they are giving fully their rated life of 800 hours. Of four replies as to the advisability of grounding the neutral of a three-wire secondary, three were emphatically in favor of grounding, while the fourth was opposed. Several replies to an inquiry as to the extent the central station should enter into competition with supply men were adverse to such competition. Four opinions in reply to a query as to the slotting of the mica of commutators were in favor of the practice.

The Southwestern Electrical & Gas Association was organized in 1899 as the Southwestern Gas, Electrical & Street Railway Association, and assumed its present name in 1904 upon the absorption of the Electrical Association of the Southwest. The territory covered includes the neighboring States and Mexico, but recently all officers have been resident in Texas, and only eight of the active member companies are in other States.

The following officers were elected to serve for the ensuing year: President, W. B. Head, Stephenville; first vice-president, W. B. Tuttle, San Antonio; second vice-president, J. E. Carroll, Beaumont; third vice-president, C. H. Dunbar, Houston; secretary, E. T. Moore, Dallas; treasurer, A. E. Judge, Tyler.

Tesla to Signal to Mars.

In a two-column letter to the New York *Times*, Nikola Tesla discusses the subject of signaling to Mars. He believes that certain electrical disturbances which he observed in the summer of 1889 must have emanated from Mars, but that all doubt in this regard will soon be dispelled. He criticised unfavorably the various methods that have recently been proposed to convey signals to Mars, and offers one of his own which he states is simple in principle, although perhaps not easy of execution. This consists, first, of a circuit properly designed and arranged, with one of its ends connected to an insulated terminal at some height, and the other to earth. Inductibly linked with this is another circuit in which electrical oscillations of great intensity are set up, the above combination being known as the Tesla wireless transmitter. By a careful attunement of circuits, and by means of certain methods which he has not yet described, oscillations of transcending intensity can be obtained. Mr. Tesla states that he has passed a powerful current around the globe, and obtained an activity of many millions of horse power; assuming that only a rate of 15 million horse power is readily obtainable, this is 6000 times more than that obtainable by the Pickering mirror method. By the employment of the proposed method, the electrician on Mars instead of utilizing the energy received by a few thousand square feet of area, as from a parabolic reflector, is enabled to concentrate in his instrument the energy received by dozens of square miles, thus multiplying the effect many thousands of times; and by proper methods and devices he can magnify the received effect as many times again. Mr. Tesla states that in his experiments in 1899 and 1900 he produced disturbances on Mars incomparably more powerful than could be obtained by any light reflectors, no matter how large.

Gasoline-Electric Car.

The General Electric Company has for several years given considerable attention to gasoline-electric cars, during which period several different types have been the subject of design and experiment. One of the latest of these is illustrated in the accompanying engravings, which has a seating capacity of 50 passengers and an 8-ft. baggage space.

The car is mounted on double trucks, the forward one being equipped with two standard railway motors of 100 hp each. The power plant consists of a gasoline engine and an electric generator of 125 hp and a controller similar to a standard railway controller. The speed of the cars is from 50 to 60

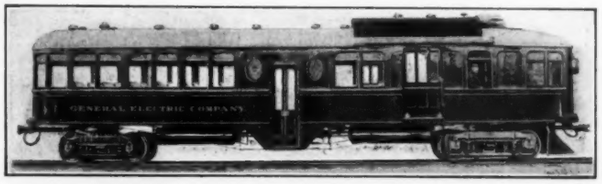


FIG. 1.—GASOLINE-ELECTRIC CAR.

miles per hour and the car can be started, stopped and reversed without stopping or changing the direction of rotation of the gasoline engine. The company believes that the flexibility and easy operation afforded by the electric drive more than counterbalance any advantage secured by a mechanical connection between the engine and the axles.

The power plant consists of an eight-cylinder, 100/125-hp, 550-r.p.m., four-cycle gasoline engine of the V type, direct connected to an eight-pole, 80-kw, 600-volt commutating pole generator and direct-coupled, 3½-kw, 32-volt exciter. Engine cooling is provided by means of thermo-siphon circulation in radiators of the fin tube type of 2000 sq. ft. cooling surface and 60 gal. capacity, suitably placed on the roof of the car. The cooling system is arranged so that it may be filled from the exterior of the car.

The ignition system consists of high-tension magneto and plugs. The carbureter is of overflow type with adjustable con-

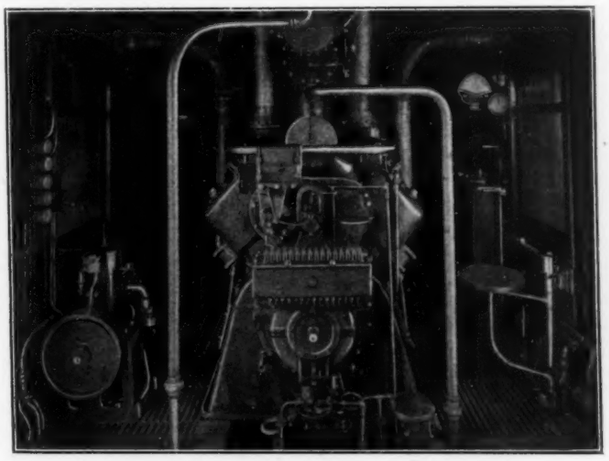


FIG. 2.—VIEW OF MACHINERY COMPARTMENT.

trol for warm air supply. The gasoline is supplied to the carbureter by means of a plunger pump mechanically driven from the engine. An auxiliary hand pump is also provided for starting. An air pump driven from the main crankshaft of the engine supplies air for the brakes and whistle. The gasoline tank is of steel and of 90 gal. capacity; it is located under the car body and is filled from the exterior of the car.

The controller connects the motors progressively in series and in parallel, and the voltage applied to them is controlled by varying the strength of the generator field, which is accomplished by the movement of a handle on the controller. The controller is provided with a reversing handle to change polarity of the armature current in relation to the field current of the motors and thus reverse the car. Substantial handles for spark and throttle are conveniently placed on the controller. The manufacturers have developed a special controller which can be arranged for operation from either the self-contained power plant or from the 600-volt overhead trolley circuit of an electric railway system. When operating from the self-contained power plant the speed of the motors is governed as described above. When operating from the overhead trolley the motors are controlled in the usual manner—i.e., series parallel connections with intermediate steps obtained by placing resistance in the main circuit. The same handle accomplishes both operations. Interlocking devices are provided to prevent operation from one circuit when there is a connection with the other.

Combined straight and automatic air brakes are provided, the straight air being for use when the car is operated alone and the automatic air for use when hauling a trailer furnished with standard automatic brake equipment. The gasoline engine is started by compressed air from the main reservoir through a distributing valve to the several cylinders in succession. For recharging the reservoirs if necessary when the main engine is shut down a single-cylinder, single-acting air pump direct connected to a 4-hp, single-cylinder, two-cycle gasoline engine is furnished as part of the equipment and is located on the left side of the engine compartment. This auxiliary air pump equipment is complete and includes all necessary accessories, such as carbureter, ignition outfit, cut-out cocks, valves, etc.

The car is electrically lighted by 25-volt incandescent lamps. Current is supplied from the exciter when the main engine is running and from a 12-cell storage battery located under the car body when the main engine is shut down. Automatic means are provided for switching the lights from one circuit to the other and also for charging the battery from the exciter. A 32-cp incandescent headlight is provided as part of the equipment. The car body is heated by a system of hot water circulation of the thermo-siphon principle, the heat being obtained from the exhaust gases.

CURRENT NEWS AND NOTES.

RETURNS FROM INVENTIONS.—In the discussion of the paper by Mr. F. P. Fish, presented at the annual meeting of the American Institute of Electrical Engineers, Dr. C. P. Steinmetz said that the direct financial gain from all of his inventions was altogether about $500. On the other hand, he believed that indirectly, in salary and reputation, he had received at least the value which the inventions possessed.

PHILADELPHIA A. I. E. E.—The annual social meeting of the Philadelphia Section of the American Institute of Electrical Engineers is to be held at Atlantic City on June 2, while the National Electric Light Association is in session under President Eglin, who is a member of the section. The members will meet for dinner at the Hotel Poinsettia, on the Boardwalk, at 7 p. m., and under the circumstances a very large attendance is expected.

THE PATENT OFFICE AND BATTLESHIPS.—In his recent A. I. E. E. paper dealing with the patent system, Mr. F. P. Fish referred to a comparison of the cost of conducting the U. S. Patent Office and the expense entailed by a battleship. A modern battleship costs complete about $12,000,000. In 1906 the receipts of the U. S. Patent Office were $1,790,921 and the expenditures $1,554,891, leaving a profit to be turned over to the Treasury of $236,030. On the basis of these figures, the cost of a single battleship would maintain the Patent Office for seven or eight years. According to the comparison quoted by Mr. Fish, the annual cost of maintaining a battleship is several times greater than the annual cost of conducting the Patent Office.

ELECTRIC HEADLIGHT ATTACKED.—The Georgia railroads have attacked the constitutionality of a State law requiring all engines on main lines to be equipped with electric headlights. Recently electric headlights have been unfavorably criticised in the West owing to their blinding glare.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y., will hold its commencement exercises on June 15 and 16. The first day will be signalized by the opening of the new Russell Sage Laboratory, when addresses will be made by Mr. R. W. DeForest, President Smith, of the Mechanical Engineers, and President-elect Stillwell, of the Electrical Engineers. On the second day a special address will be delivered by President Bates, of the Civil Engineers.

EDISON CONCRETE HOUSES.—Mr. Thomas A. Edison announces through the newspapers that he has completed his scheme for building a concrete house for $1,200 which, if constructed of stone in the same design, would cost between $20,000 and $30,000. The house would have a floor plan of 25 ft. x 30 ft. and contain six rooms, bathroom and cellar, and could be built in a fortnight. The plant of cast-iron molds, etc., for building such a house would cost $40,000, with which 150 houses could be built in a year.

BURN THE UNIVERSITIES!—In a letter to the members of the Illinois Legislature attacking technical education in general and the University of Illinois in particular, Mr. R. T. Crane, of Chicago, says that "instead of appropriating funds for such institutions it would be a good deal better for the State to put a torch to them and burn them down, to go out of the 'higher education' business and permit the boys to go back to their homes and assist in supporting their families, instead of causing them a heavy expense."

SENATE INCREASES DUTY ON HIGH-GRADE CARBONS.—The United States Senate on May 21, by a vote of 43 to 35, fixed the rate of 35 cents per 100 ft. on low-grade and 65 cents per 100 ft. on high-grade electric light carbons. In the acrimonious debate on the subject of the duty it was stated that none of the former grade is imported. The high-grade carbons, such as are used in flaming-arc lamps, have heretofore been imported in lengths of 24 in. to 28½ in., paying a duty of 90 cents per 100 lengths. The Senate duty is therefore a virtual increase from 90 cents to $1.30 or to $1.42 per length.

CAMBRIDGE SUBWAY CONSTRUCTION BEGUN.—The construction of the new subway to be built in Cambridge, Mass., by the Boston Elevated Railway, has been begun at the intersection of Bay Street and Massachusetts Avenue. The subway will provide a rapid transit route between the business center of Boston and Harvard Square, Cambridge, and the running time will be cut from the present 22 minutes to about 8 minutes. At Harvard Square free transfers will be given between the subway trains and surface cars connecting with outlying points. The third-rail system will be installed, and multiple unit operation applied to the train service.

DUTY ON TUNGSTEN.—In a discussion in the Senate on May 21, concerning the imposition of a duty of 25 per cent ad valorem on tungsten, inquiry was made concerning the present price of tungsten. Senator Heyburn said that the price was $400 per ton; Senator Burton said that tungsten sold for $900 per ton; Senator Aldrich said he had been informed by men engaged in the tungsten industry that it sold for $1,300 per ton, and Senator Nelson quoted from a pamphlet which stated that tungsten ranged in price from $1,200 to $1,500 per ton. As a result of the discussion the matter of duty on tungsten was put over for future consideration.

ELECTRIC VEHICLE DATA.—A census has been taken recently by the *Electrical World* of the various features of the development of the electric automobile field by central stations. Already returns have been received from nearly 1400 central-station companies. It is desired to make the census as full and complete as possible at an early date, and the earnest request is now made by the editors that any blanks not yet filled out should be attended to at once and sent in. The census has already brought out the fact that central-station managers are intensely eager to learn what their colleagues are doing in this respect of building up a new and profitable load for their plants; and such interchange of information as this inquiry affords should be most valuable to them.

ENGINEERS' SOCIETY OF PENNSYLVANIA.—A meeting will be held at Harrisburg, Pa., June 9-11, at which the organization will be perfected of the Engineers' Society of Pennsylvania. The new body will include all branches of the engineering profession, and will hold an annual convention for the discussion of engineering subjects. At the coming meeting 20 papers will be presented and an illustrated lecture delivered on the Panama Canal by a member of the Panama Board of Consulting Engineers. Arrangements have been also made for visits to a number of plants, etc., of engineering interest. Mr. F. Herbert Snow, Harrisburg, is president and E. R. Dasher secretary of the society. Prof. J. P. Jackson, of Pennsylvania State College, is one of the vice-presidents.

STRAY CURRENT BRINGS TWO FRIENDS TO BLOWS.—Escaping electricity which charged the Twelfth Street bridge in Chicago recently caused a curious misunderstanding. Two men who were well acquainted and on friendly terms approached the bridge, one slightly in advance of the other. The first man stepped on a car rail and received a smart shock. He jumped, and believing his companion had jolted him severely, he quickly turned and struck the latter. The compliment was returned in kind, but in the scuffle the two men received other electric shocks and realizing that electricity was their adversary they laughed and shook hands just as a policeman was about to interfere. The cause of the escaping electricity was then quickly located and easily repaired.

AN EDITOR VINDICATED.—About two years ago our contemporary *Power* printed an article exposing the pretensions of the promoter of a carbonic gas engine which, it was claimed, would, in the absence of leakage, run indefinitely with a single charge of gas under pressure; or more specifically, that it would in practice continue to run and develop power in large and useful quantities for some 30 days without any other source of energy to draw upon. In consequence of the publication of the article, Mr. F. R. Low, editor of *Power,* was arrested on a charge of criminal libel, and the suit was tried in Philadelphia on May 13. The judge, after hearing only part of the evidence prepared for the defendant, instructed the jury to find a verdict in his favor, which verdict was duly rendered.

ARMOUR INSTITUTE GRADUATING CLASS.—Armour Institute of Technology, Chicago, will graduate a class of 27 in the electrical engineering course this spring, all of whom will receive the degree of B.S. This degree will also be conferred on 14 graduates in mechanical engineering, 19 in civil engineering, 7 in chemical engineering, 4 in fire-protection engineering and 3 in architecture. Advance degrees will be conferred on five men in the electrical engineering department, five in civil engineering, four in mechanical engineering and one in chemical engineering. The theses of the electrical engineering graduates cover a variety of subjects, including tests and examinations of lightning arresters, the permutator, railway motors and electrification projects, current transformers, photometers, primary cells, measuring instruments, transformers, incandescent lamps and also a report on one isolated plant.

System of the Philadelphia Electric Company

GENERATION, DISTRIBUTION AND SALE OF ELECTRICAL ENERGY IN THE QUAKER CITY

THE city of Philadelphia has an area of 129 sq. miles and a population of about 1,500,000. Covering this vast territory are the lines of the Philadelphia Electric Company, the only public-service company selling electricity in the city. In the district comprising the old city founded by Penn in 1682, and extending from the Schuylkill to the Delaware River, and from South Street to Callowhill Street, a three-wire, 115-230-volt system of distribution prevails. The feeders and distribution circuits are for the most part underground. In the outlying territory a two-phase, three-wire, 60-cycle system is used, and inasmuch as most of the consumers are connected to 115-230-volt secondary mains, a uniform distributing voltage is maintained in the entire city. The alternating current is generated at 6000 volts and is distributed by means of substations at a tension of 2400 volts. The 6000-volt feeders are run underground, and the 2400-volt distribution lines are principally overhead. The chief generating stations of the company are Station A, located at Twenty-eighth and Christian Streets; Station G, Twenty-sixth and Callowhill Streets; Station C, formerly the Edison Station, at Ninth and Sansom Streets, and Station J, which is located in the northeastern section of the city. It is planned eventually to maintain practically two generating stations, Station A and Station J.

STATION A.

This station is located on a plot having an area of 335,000 sq. ft. at Twenty-eighth and Christian Streets and the Schuylkill River. The site is especially valuable for power-house purposes as it is free from intersecting streets, has the river on one side and the Baltimore & Ohio Railroad and the Pennsylvania Railroad immediately adjoining it. The location insures ample water at all times for feed water and condensing purposes; fuel can be brought by rail and by water, and a large, well-paved street facilitates the hauling of miscellaneous supplies. A map of the property is given in Fig. 5. The present station is 160 ft. x 160 ft. in cross-section, and houses about 25,000 kw of generating machinery at normal rating. This is one complete section of the projected plant, which will comprise five such sections and have a total rating of 125,000 kw. The second section will be built directly east of the present structure, or on the end away from the Schuylkill River. The structure is built of steel with heavy red-brick outer walls and with windows for light and ventilation on three sides. The fourth side is closed with a temporary galvanized-iron sheet-metal wall, heavily braced against wind pressure, which will be removed when the next section is completed. A skylight of heavy wire-glass covers the central part of the engine-room. The roof proper is made of cinder concrete, and extending over the coal bunkers are copper

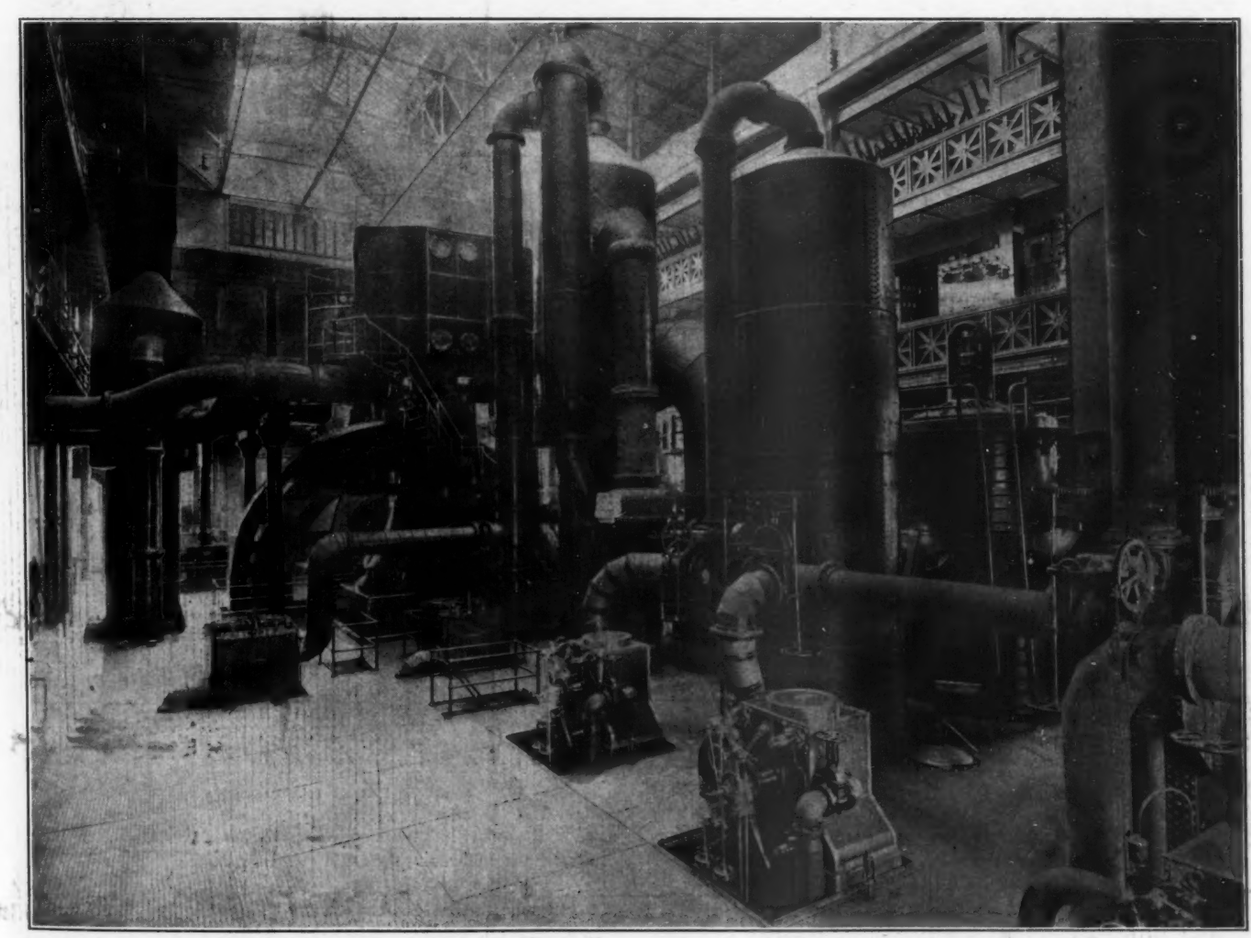


FIG. 1.—GENERATOR ROOM OF THE CHRISTIAN STREET STATION OF THE PHILADELPHIA ELECTRIC COMPANY.

louver to provide ventilation for the bunkers, and to carry away the heat from the fireroom floors. The engine-room floor is 20 ft. above the basement floor, and is lined with white-enameled brick for a distance of 6 ft., and buff brick above this to the full height of the building. An ornamental red tile floor with a border of diamond-shaped figures of deep green is provided. In order to give ready access to the condensing equipment lo-

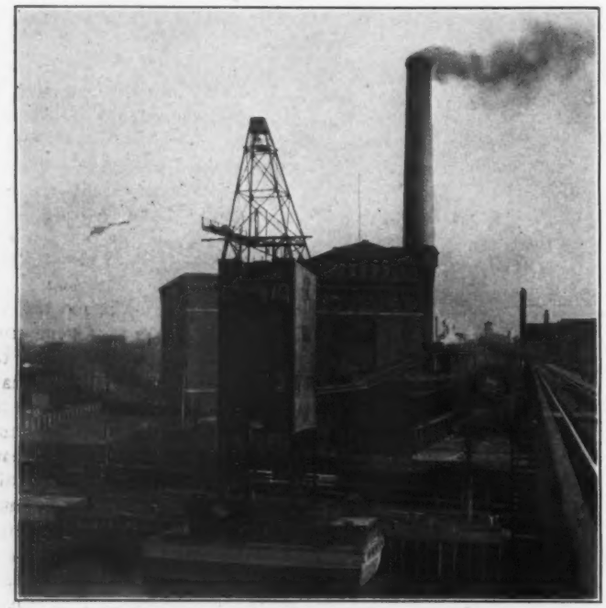


FIG. 2.—COALING ARRANGEMENTS AT CHRISTIAN STREET STATION.

cated in the basement, which is at street level, the section of the floor immediately over the pumps is covered by steel plates, which are removable, so that the condensing machinery may be handled by means of the crane in the engine-room. The latter is of 60 tons capacity and runs the full length of the engine-room. It is electrically operated, and has an auxiliary hoist of 5 tons capacity for handling lighter parts.

The generating equipment comprises a 2000-kw, two-phase, 6000-volt alternator, direct connected to a Wetherill twin-tandem-compound engine; a 5000-kw alternator, direct-connected to an Allis-Chalmers double-horizontal-vertical, cross-compound engine and three 5000-kw, five-stage Curtis turbo-generators. The 2000-kw unit is equipped with a vertical jet condenser of the Deane type. The Allis-Chalmers engine exhausts directly into a Weiss barometric condenser giving a vacuum averaging about 28 in. throughout the year. The governor of this engine is of the flywheel type, giving a regulation of about 2½ per cent from no load to full load. In order to insure satisfactory operation with the very heavy valve gear, this governor transmits its motion to the valve gear through a hydraulic cylinder, the piston of which is directly connected to the valves. A safety governor is provided to cut off steam from the engine in case of excessive speed. One of the turbo-generators operates at a normal speed of 514 r.p.m., while the two others run at 720 r.p.m. Safety trips, which protect the machine in case of excessive speed, are set for 15 per cent to 20 per cent above normal. Two turbines exhaust into barometric condensers designed by the company's engineer, and a vacuum of over 28 in. is maintained on the three turbines at all times. The step-bearing pressure of the 14-pole turbo-generator unit is 550 lb. per square inch, while the pressure for the 10-pole turbo-generator unit is 775 lb. The turbines have proved extremely satisfactory in operation, so that the load is generally carried upon them at all times, except when an increase calls for the use of the reciprocating engine units.

An accumulator 12 in. in diameter by 10 ft. stroke acts as a reserve upon the step-bearing system. The pressure varies directly with the load, and care must be exercised that the sudden overloads which sometimes have to be carried on the generators do not cause the pressure to rise to a point approaching that of the accumulator, as the step blocks would rub and cut very rapidly. In the two 10-pole turbo-generator units, which have smaller blocks than the other turbo-generator, the area of the recess in the blocks was considerably increased, with the result that the necessary pressure at no load was found to be reduced. The increase in pressure due to the load was also reduced, so that a much flatter curve was obtained, which made it impossible under any conditions of load for the step-bearing pressure to approach that of the accumulator. An oil flow of about 12 gal. per minute is maintained at each step block.

In connection with the accumulator four heavy accumulator pumps are installed, any two of which can carry the combined load of the three turbines. The pumps are of Worthington manufacture, and two of them, together with the main and auxiliary accumulator, are shown in one of the engravings. The piping between the pumps, accumulators and step bearings is of heavy steel, and each section, together with all fittings used in connection with the 150 lb. oil supply to the turbine governors, were tested above the working pressure before being placed in service.

The importance of maintaining the quality of machinery oil has led to the adoption of a gravity supply and filter system of ample size to meet all requirements. There is kept on hand in the station a constant supply of 20,000 gal. of machinery oil, one-half of which, owing to the design of the storage tanks, may be kept in reserve indefinitely. This oil is used for every purpose around the station, including the step bearings of the turbines. With the facilities on hand for warming, filtering and

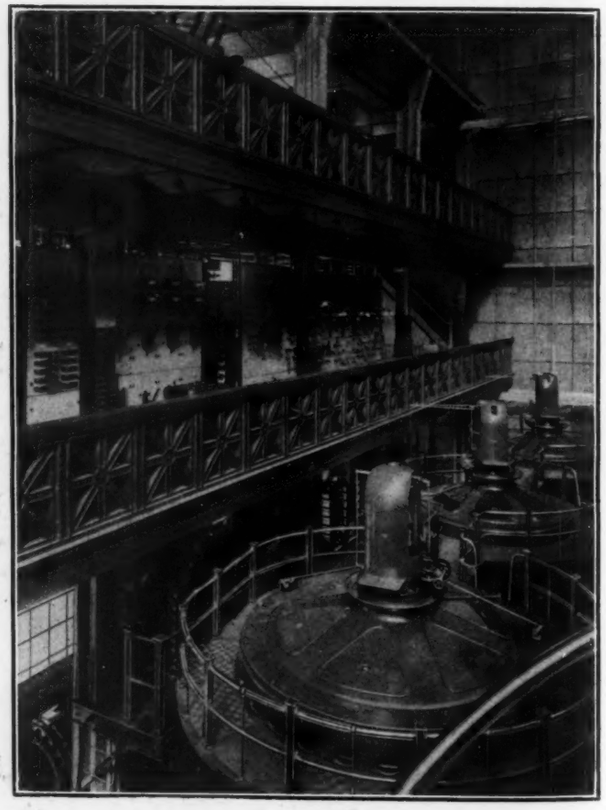


FIG. 3.—TURBO-GENERATORS AND SWITCH GALLERIES IN CHRISTIAN STREET STATION.

cooling the oil it has not been noticed that the use of machinery oil on the step bearings of the turbines detracts to any extent from its quality.

Inasmuch as the temperature of the water in the Schuylkill River varies considerably between winter and summer, about twice as much water is required for condensing purposes in

summer as in winter. The tidal conditions are also such that centrifugal pumps are not best adapted for this work. Rotary pumps of a positive-displacement type, whose output varies directly with the speed, are therefore installed in connection with the turbines, and have proved very suitable for this work. The general appearance and construction of the units may be seen by reference to the cross-section of the building.

The boiler equipment occupies two floors, each carrying 16 Babcock & Wilcox boilers having a normal rating of 630 hp, and supplying superheated steam at a pressure of 175 lb. At the present time most of the furnaces are hand-fired, although several types of stokers have been installed for experimental purposes. Bituminous coal is supplied from barges on the Schuylkill River, and a railroad siding with a hopper is also provided. The coal-handling apparatus at the river edge consists of a Mead-Morrison coal tower, having a total lift of 85 ft. from river to boom. The coal is lifted from the barge by a 1¼-ton clam-shell bucket at the rate of approximately 150 tons per hour. The bucket dumps the fuel into an apron, from which it drops into a crusher, whence it is loaded into 3-ton cars on a cable railway and automatically dumped into a hopper at the station. Two men are required to handle the coal conveying apparatus on the upper floor of the tower and two additional men handle the small cars. The two-roll crusher at the tower and the cable railway are both driven by induction motors having a horsepower rating of 30.

At the station the coal-handling apparatus consists of a Link-Belt two-roll crusher, together with a bucket elevator rated at 150 tons per hour. By this means the coal is lifted from the ground to the bunkers, and distributed by longitudinal conveyors, one on each side of the bunkers. The capacity of the coal bins is 2000 tons, or 13 tons per lineal foot of the station. The fuel is distributed through pipes leading from the bunkers directly to the middle of the fireroom floor in front of each boiler. The bunkers being divided into sections, any trouble due to spontaneous combustion is not serious, since the section of the bunker affected can be quickly emptied. All of the steel work in the bunkers is protected by a layer of concrete at least 2 in. thick. The ashes from the furnaces are dropped through chutes to the basement, whence they are removed by means of steel cars of the dumping type run on a light steel rail directly over a drain through which all water in excess of that actually needed for cooling the hot ashes is carried off to the sewer.

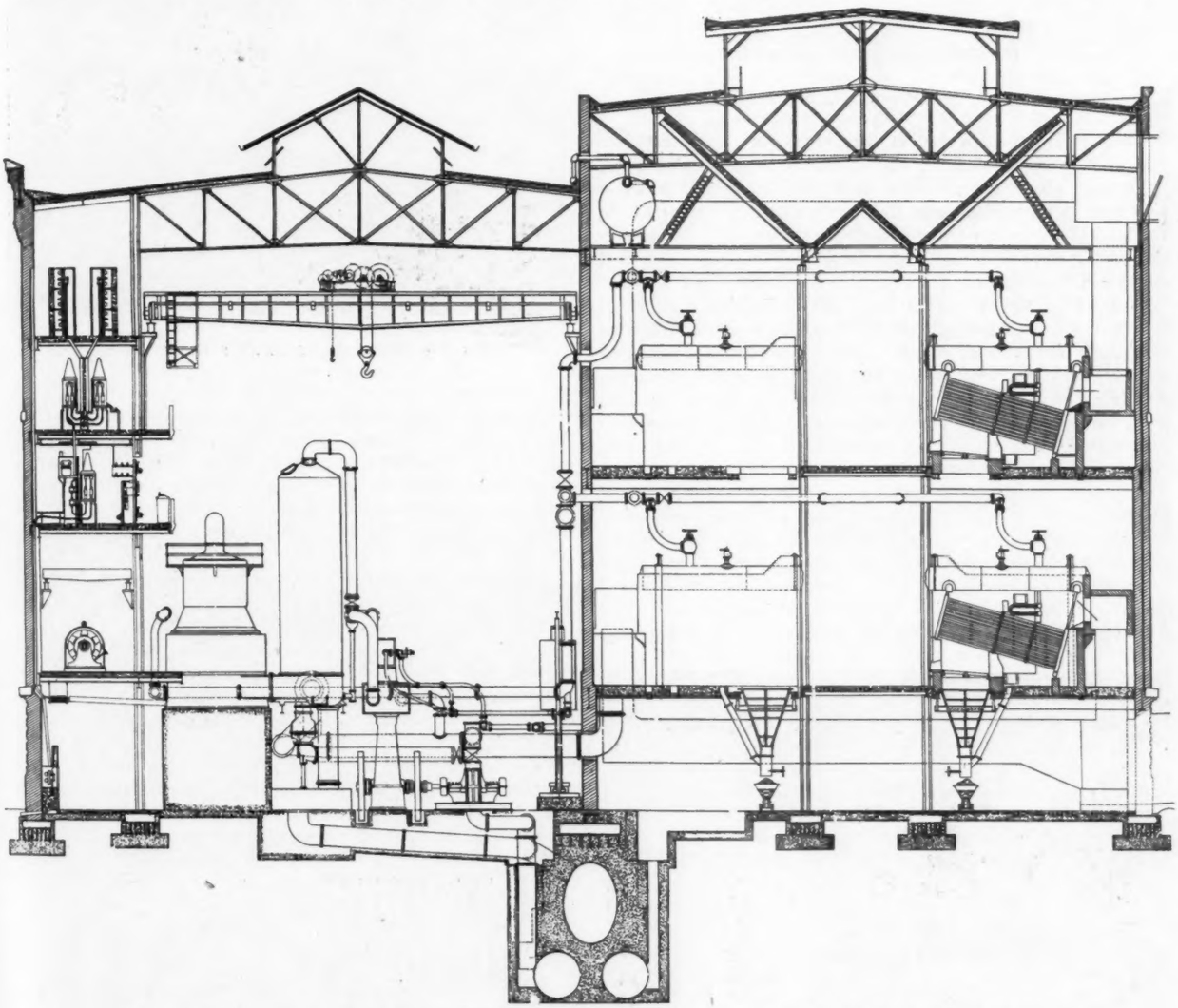


FIG. 4.—CROSS-SECTIONAL ELEVATION OF CHRISTIAN STREET STATION OF THE PHILADELPHIA ELECTRIC COMPANY.

The boiler-feed pumps are located at the street level in that portion of the basement lying between the engine-room basement and the ash-handling equipment. This section of the building is closed by heavy brick walls, perforated at intervals with openings protected by self-closing doors. The apparatus in this section is arranged in three groups, each of which is capable of supplying feed water to the entire boiler system of the plant. Water is taken from the hot well at about 100 deg. Fahr. by the heater pumps and is passed through Cochrane open heaters. The exhaust from all auxiliaries, together with the discharge of all steam traps, is directed into these heaters so that the water delivered by the boiler-feed pumps has an average temperature of about 190 deg. Fahr. Section No. 1,

located next to the river, and section No. 3 farthest from the river, have heavy combination flywheel pumps, each of which is driven by a vertical compound engine. The steam cylinders are connected to an independent crank, which operates both the heater pumps and the boiler-feed pumps at the same time by means of a walking-beam connection. A special governing

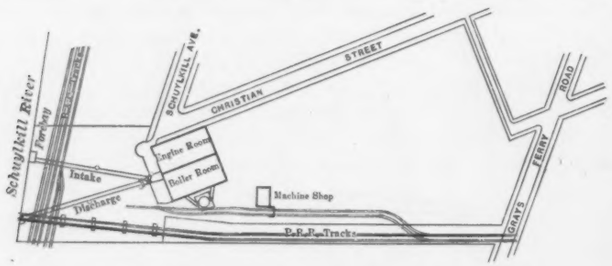


FIG. 5.—PROPERTY MAP, CHRISTIAN STREET STATION.

mechanism is provided so that the pumps may be operated at whatever speed is desired, the normal full-load speed being 75 r.p.m. These pumps were built by Robert Wetherill & Company in accordance with the specifications and plans of the mechanical engineer of the Philadelphia company. Pump section No. 2 comprises two Snow duplex boiler-feed pumps and two small heater pumps.

Water from the Schuylkill River for condensing and boiler-feed purposes is conveyed 350 ft. through cast-iron segmental conduit, bolted together in 2-ft. sections, the tunnel being 10 ft. 2 in. in diameter. Portions of this tunnel are laid in concrete, and in other places the foundation is of clay, gravel or solid rock. Water enters the concrete forebay through a heavy iron grating with bars 1½ in. between centers. Each of the three river openings measures 8 ft. 10 in. high. Inside of the forebay another double set of screens of 1½-in. mesh, constructed of heavy copper wire, is arranged. The screens are removable for cleaning, the upper screen being balanced over a pulley against the lower screen and the intermediate screen being carried by a balance weight. The bottom of the opening into the river front is 8 ft. 10 in. below normal low water.

Under the station the cast-iron tunnel changes in form by

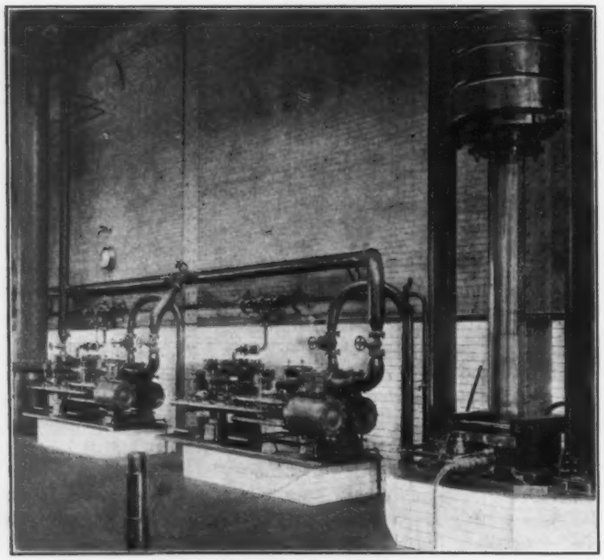


FIG. 6.—ACCUMULATORS AND STEP-BEARING PUMPS.

means of a 30-ft. long concrete section to the two 7-ft. circular tunnels, shown in the cross-section under the middle wall of the station. The bottoms of these tunnels are 8 ft. below mean low tide. Five suction pockets are located at the side of the north tunnel for the condenser pumps. Pockets of smaller diameter are located on the fireroom side of the other tunnel for the boiler-feed or fire pumps. Openings, 4 ft. in diameter, are provided at frequent intervals between the tunnels. The discharge conduit under the building shown in the cross-sectional elevation is elliptical in shape, having a vertical major axis of 12 ft. and a minor axis of 8 ft. The tunnel changes in the section directly outside of the building, being reduced in the same

FIG. 7.—FEEDER COMPARTMENTS IN BASEMENT.

concrete section as the intake to a diameter of 10 ft. 2 in.; cast-iron sectional conduit leading directly to the river. As shown in the plan view of the property, this discharge conduit empties into the river about 200 ft. below the intake so that the hot discharge water does not mingle with the condensing water.

Running lengthwise of the station in the basement on the Christian Street side are compartments of concrete and alberene stone for the outgoing 6000-volt feeders. This section is separated from the engine foundations and from the steam-driven auxiliaries of the plant by a low wall. At the present time there are four groups of such compartments, each of which is equipped with six high-tension cables. No lead-covered cable is installed on any high-tension circuit within the station, all such wiring consisting of single conductors heavily insulated with rubber and braid. In the cross-sectional elevation of the building it will be noticed that the cables run to disconnecting knife switches, thence to the first mezzanine gallery, where are located the main automatic oil switches, back of which are the necessary series and shunt transformers for the instruments. Passing directly from the automatic oil switches

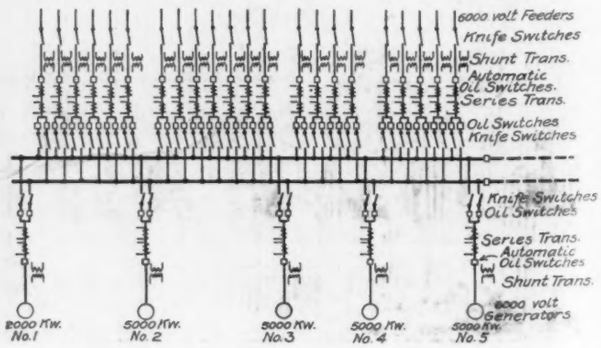


FIG. 8.—DIAGRAM OF BUSBAR CONNECTIONS IN MAIN STATION.

and transformers, the feeders ascend through concrete and tile ducts to selector switches, which standing back to back, connect the feeder directly to the busbars overhead. These oil switches may be operated manually or controlled from the benchboard. Located on the highest gallery are the two main two-phase, three-wire system busbars, which run the entire length of the

plant. Each bus is built up of 4 in. x ¼ in. copper bars and is placed in a separate fireproof compartment and mounted on heavy porcelain insulators set in alberene stone slabs directly in the concrete.

Knife switches similar to those in the basement allow any feeder or generator to be disconnected from the bus in case it

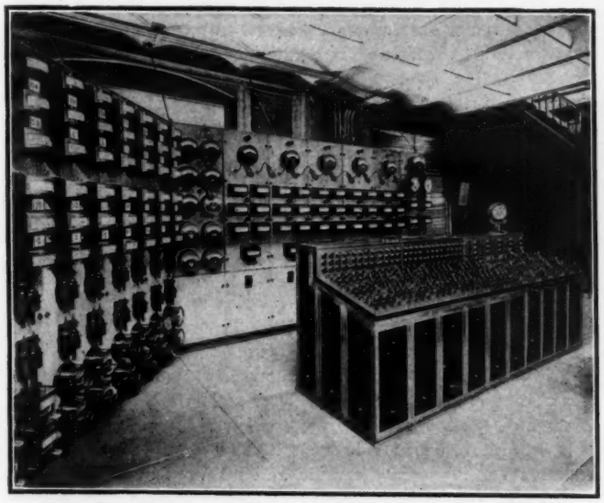


FIG. 9.—CONTROL BOARD IN CHRISTIAN STREET STATION.

is desired to work on the oil switches or other parts of the apparatus. By means of interlocking doors and a special lock, the key of which can only be obtained on application to the chief operator, the switches in the basement are securely kept from interference. In this way, in case of trouble on the underground system, the station operator, after opening the knife switches, can lock the compartment doors and be entirely sure that it is safe for the underground department to work on

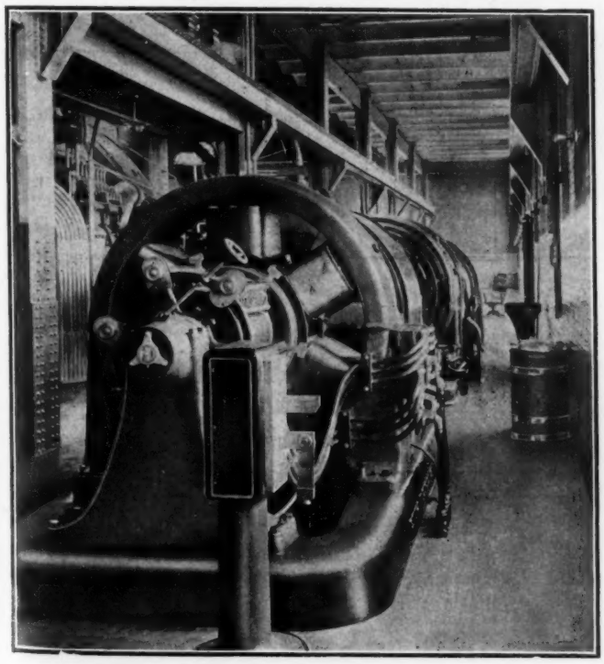


FIG. 10.—MOTOR-GENERATOR EXCITER SETS IN MAIN STATION.

the system. A diagram of the 6000-volt connections is given, and this shows the general arrangement of the alternator and feeder wiring.

The exciters of the station consist of a 100-kw, high-speed steam-driven 250-volt generator; one 150-kw generator driven by a 6000-volt induction motor of Westinghouse build; one 300-kw generator driven by a General Electric 6000-volt induction motor, and one 50-kw machine for battery charging, operated by a General Electric 6000-volt induction motor. In addition there is installed a battery of 140 cells, having a capacity of 400 amp-hours at a one-hour discharge rate, with sufficient space in the tanks for increasing the number of plates 50 per cent. By means of an end-cell switch the number of cells in circuit may be increased from 122 to 140, two cells at a time. The storage battery is kept floating on the exciter system at all times, and the exciters themselves are equipped with reverse-current circuit-breakers on the direct-current side and overload circuit-breakers on the alternating-current side.

The direct-current board is located directly above the exciters on the first gallery, the exciters being located on the Christian Street side of the engine-room floor. Two sets of busbars are provided, and the field coils of any machine and all auxiliary apparatus operating controlling mechanism, etc., are arranged with double-pole, double-throw switches, so as to be

FIG. 11.—MAP OF 6000-VOLT CABLE SYSTEM.

operative from either bus. The direct-current board is on the same floor as the main feeder and generator switches. Located directly above the direct-current board on the same gallery with the hand-operated selector switches are the benchboard and the instrument panels for all feeders and generators, including panels for synchronizing and other general indicating instruments and for duplicate sets of indicating instruments for each exciter and exciter battery. On the extreme eastern end of the board are mounted an illuminated-dial voltmeter indicating the pressure on the exciter system; a frequency indicator for each bus; a voltmeter for each bus; an auxiliary end-cell indicator and switches for controlling the direct current supplied to the oil switches, relays and the benchboard. A double set of synchronizers and synchronizing switches are also provided, so that in case of trouble with any set of synchronizing transformers another set on an entirely different phase can be thrown into service by the operation of one switch.

As shown in Fig. 9, the benchboard is divided into two sections, one section comprising 24 feeders and the other controlling the five main generators. Upon the lower board are mounted the controllers for the main field rheostats, switches for the speed control of the generators; field break switches, and the small controlling switches for the generator oil switches. The other board has installed on it switches for con-

trolling the motor-operated oil switches of the feeders. The red or "in" lamps on this benchboard are located on a vertical panel. The upper row of red lamps is for No. 1 bus, the lower row for No. 2 bus and the middle row for the main or automatic switches of the feeder or generator. Dangerous overloads on the generators are automatically indicated by the lighting of a red lamp through a relay. Small switches are arranged in three rows: those for No. 1 bus are on the bottom, those for No. 2

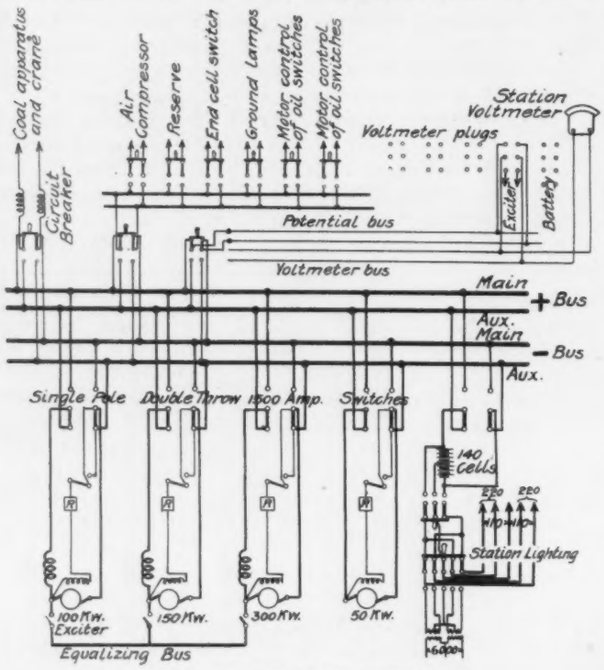


FIG. 12.—EXCITER BOARD CONNECTIONS.

bus are on the upper row and, as in the case of the lamps, the main switches lie midway between the selector switches. By glancing down the row of switches or the row of indicating lamps the operator can see at a glance which generator or feeder is in service. The green, or "off," lamps being of less relative importance are located on the inclined slab under the front of the switch, so that their indication is not concealed by the hand of the attendant during switching operations. Underneath the table are fuses for the protection of the motors on the oil switches and other motor-driven appliances, synchronizers and frequency indicators controlled directly from the table. Mounted on the generator end of the table is a double-scale Hartmann & Braun frequency indicator, which by its vibration indicates the exact frequency of both buses. This type of frequency indicator has been found very satisfactory, and has practically superseded in the Christian Street station all other forms. The general layout of the whole electrical equipment can be seen by a reference to Fig. 4, which shows the Christian Street side of the building. Above the engine-room floor are the main automatic switches with the direct-current board; on the gallery above are the selector switches and instrument board and the operator's table, and on the gallery above these are the busbar compartments, and on the river end the storage battery.

Radiating from Christian Street are 20 6000-volt underground three-conductor cables of 250,000-circ. mil cross-section. These feed the various substations, where the potential is stepped down to 2400 volts by means of air-blast transformers, or to 220 volts, direct current through rotary converters or synchronous or induction motor-generator sets. The direct current is used to supply the underground Edison service in the heavily congested districts of the city.

STATION G.

This was the first complete alternating-current generating station installed by the company and contains four 1000-kw, two-phase units operated by twin tandem-compound condensing engines and has been fully described. This plant is now used as an emergency station. The first two engines installed were of the Greene type, built by the Providence Steam Engine Company. They are equipped with governors of the Rites type driven by two belts each and damped with a special locking dash-pot with a floating valve to assist in parallel operation. The last two machines are of the Pennsylvania Iron Works Company build. Wheeler surface condensers are used. The four alternators are equipped with 30-kw, belt-driven, 125-volt, shunt-wound exciters and in addition there is installed a 50-kw Siemens & Halske 125-volt, compound-wound exciter direct-coupled to an Armington & Sims high-speed engine. The plant is equipped with a modern switchboard using hand-operated oil switches and all indicating instruments, as well as the operating handles of all switches, are on a gallery above the high-tension apparatus.

The boiler equipment comprises eight Aultman & Taylor boilers fitted with flat grates and superheaters. All boilers are hand fired with hard coal. Two 12-ft. Buffalo Forge Company's fans are installed in the boiler-room, one at each end, with ducts leading to the boiler furnaces. These are used for forcing the fires under the boilers in case of sudden rise in load. The stack is an ornamental structure, rectangular in shape, with a circular bore 9 ft. in diameter and is 150 ft. high.

Ten high-tension cables of 115,000-circ. mil section transmit energy to the various substations. The plant is still kept in readiness for immediate service and in the winter is used to carry a part of the peak load when this is necessary.

STATION J.

The district supplied by Station J, located on the Delaware River, at Tacony, includes certain large manufacturing industries which are centered relatively near the station. A new substation is now under way to care for the proper distribution of the load in this territory. Eventually this substation will probably be tied in with the outlying substations fed from

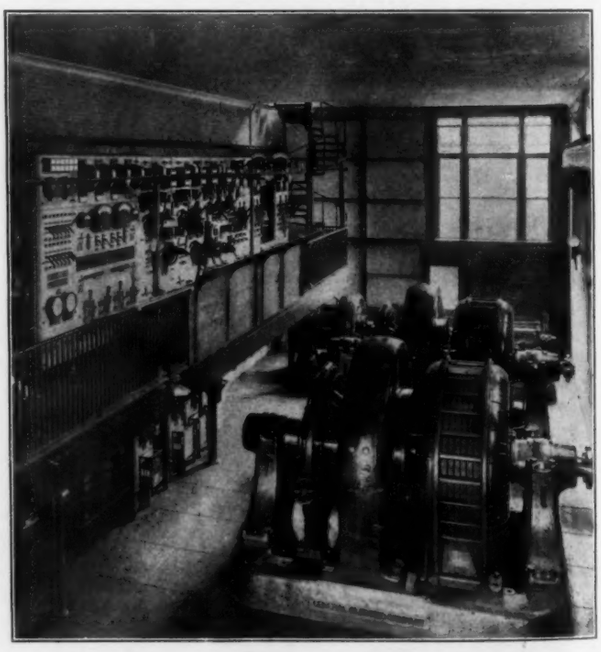


FIG. 13.—GENERAL VIEW OF STATION Q.

Christian Street and the whole of the northern district of the city will thus be well protected in case of serious cable troubles. Station J, an interior view of which is given herewith, contains 2640 kw in alternating-current machinery and feeds besides 1750 arc lamps.

STATION C.

The Edison system is supplied with energy from Station C, having steam-driven machinery rated at 4500 kw and 1600 kw

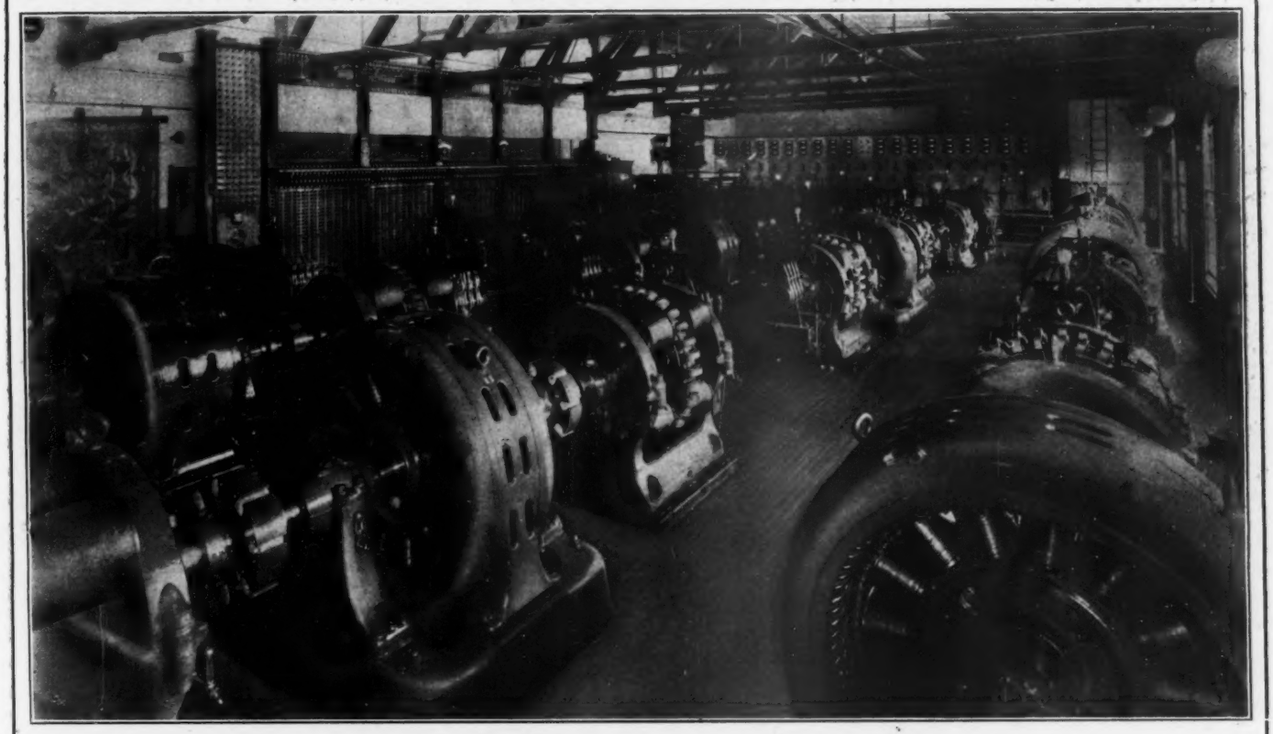


FIG. 14.—MOTOR-DRIVEN ARC MACHINES IN STATION F.

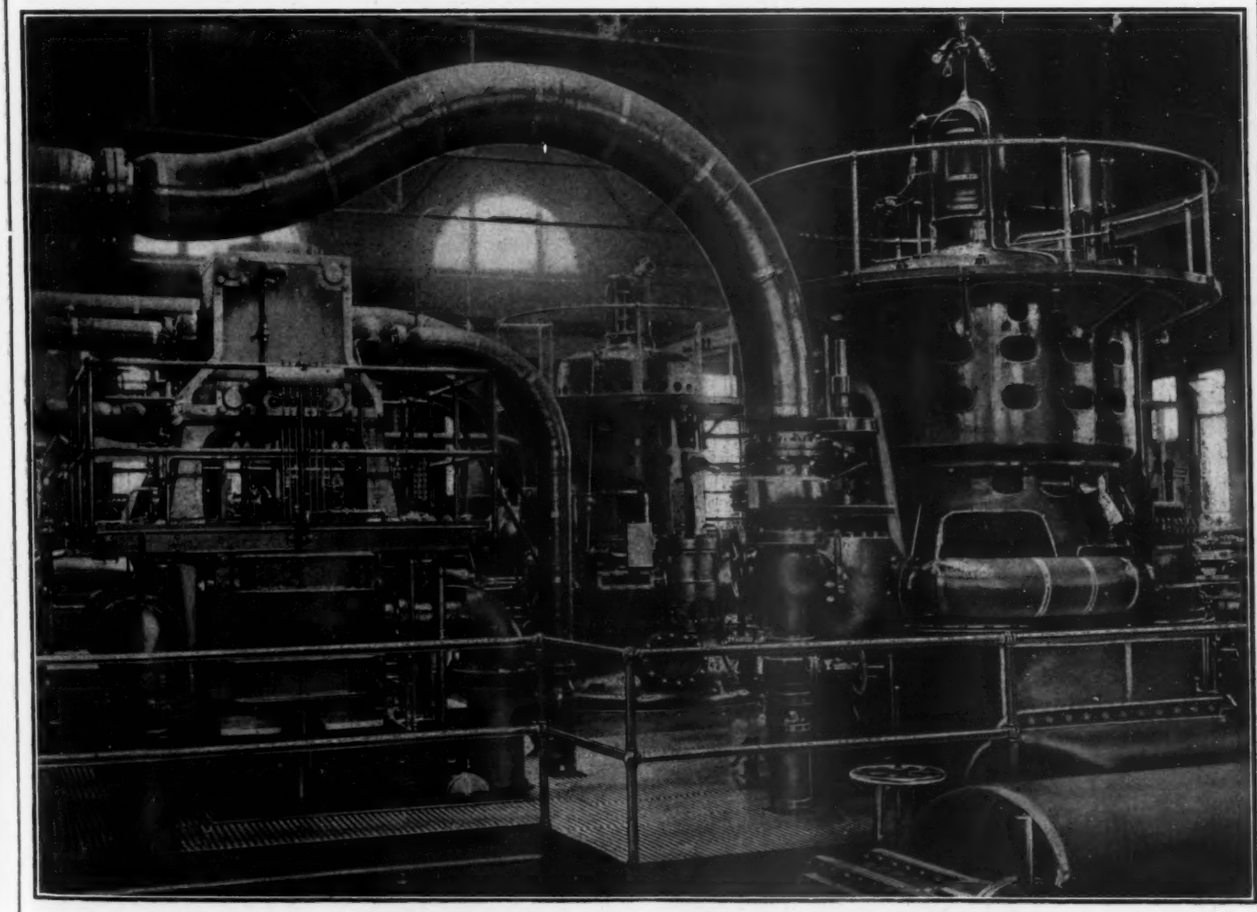


FIG. 15.—GENERATING EQUIPMENT IN STATION J ON THE DELAWARE RIVER AT TACONY.

GENERATING STATIONS OF THE PHILADELPHIA ELECTRIC COMPANY.

of transforming apparatus and from three substations which are supplied from Station A. The substations are located so as to feed into the network at points of heavy load where the feeder drop would make direct-current supply from the central direct-current station unsatisfactory.

During the rebuilding of the Philadelphia system many of the district stations were retained and converted into substations. In some cases, however, the growth of the load has necessitated the construction of complete new stations at points carefully selected with a view to the future as well as the present load.

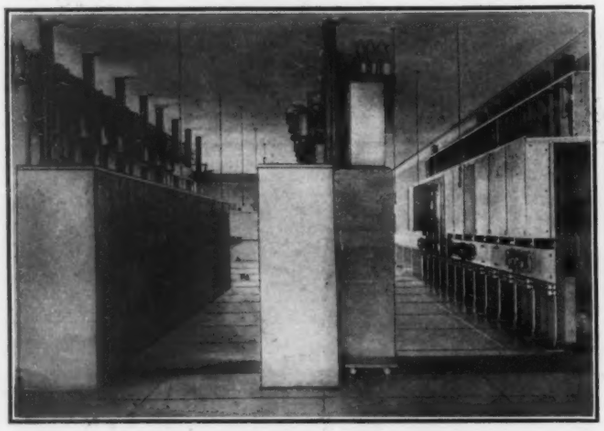


FIG. 16.—BUSBAR COMPARTMENTS, STATION Q.

STATION Q.

One of the latest stations to be erected in the Edison district is located on Arch Street, between Eleventh and Twelfth Streets, and running back to Cherry Street. The present station is located on the Cherry Street end of the property and ample space is available for extending the station to any size that would be called for at this location. The illustrations show the equipment in this station so well that extended descriptions are unnecessary. The incoming 6000-volt feeders and the outgoing direct-current feeders are on the first floor, together with the 1000-kw, 6000-volt, 60-cycle synchronous motor-generator sets, rheostats, etc., the operator controlling the entire apparatus from the gallery. The upper floor contains the 6000-volt buses and the solenoid-operated oil switches. The direct-current generators are provided with interpoles so that commutation at all loads and under all conditions of operation is very satisfactory. A motor-driven blower supplies air to the commutators at extremely high overloads. Under normal conditions it has not been found necessary to use this blowing attachment to any great extent. The machines are started from the direct-current side, synchronized and then thrown directly on the 6000-volt buses. In the basement of the station is installed a storage-battery plant of chloride accumulators, the present rating of the equipment being 450 kw.

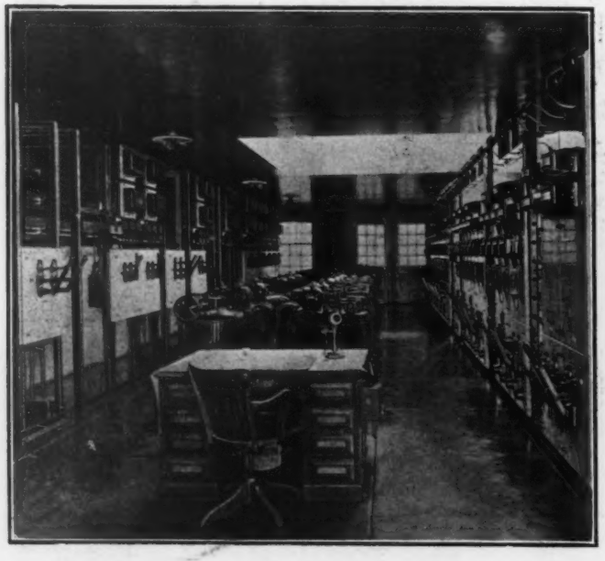


FIG. 17.—AUTOMATIC REGULATORS AND CONTROL BOARD IN STATION O.

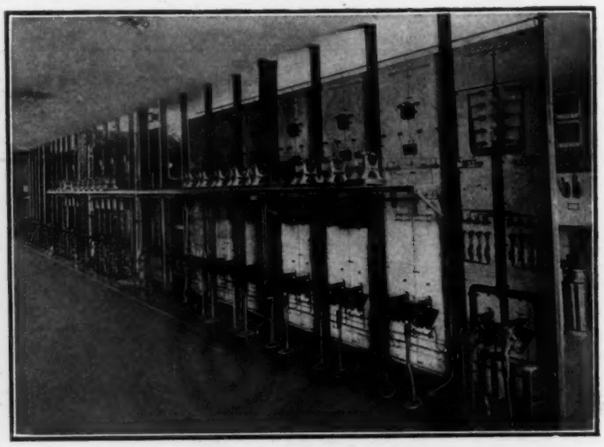


FIG. 18.—REAR VIEW OF SWITCHBOARD, STATION O.

STATIONS O AND P.

Two of the latest type of transformer substations are located at Marshall and Noble Streets and at Fortieth and Market streets, respectively. These are designated station P and station O, and both are illustrated herewith. Each of these stations has been designed for an ultimate output of 4000 kw divided between four 1000-kw banks, each consisting of two 500-kw transformers. These transformers step down from 6000 volts to 2400 volts, and are of the air-blast type provided with adjustable dial heads for giving suitable voltage at the secondary terminals. Automatic regulators with compensating voltmeter attachments acting through relays keep the voltage constant at any desired potential. The capacity of each regulator is 16½ kw, permitting a voltage range of 15 per cent. The distributing circuits of the alternating-current substations have been limited to a load of 500 kw each. The stations operating entirely automatic, the duty of the operator consists in keeping the building and apparatus clean and in carefully inspecting the relays. A diagram of the substation connections shows that it is possible to operate the station and care

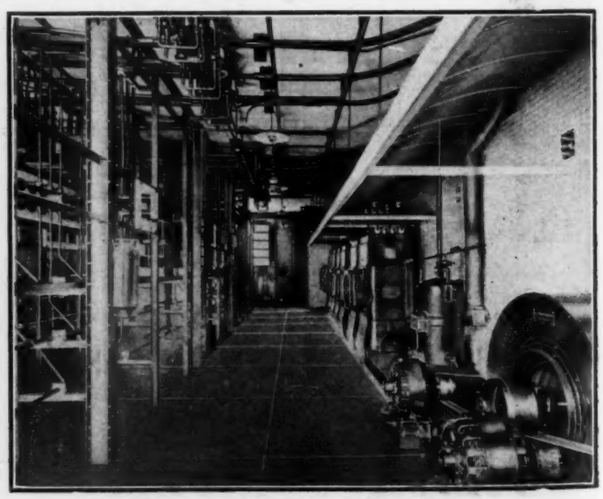


FIG. 19.—BASEMENT OF STATION O.

for all circuits even though one or more of the regulators may be in trouble or any mishap occur to the series or shunt transformers. Service from these substations is all overhead.

DISTRIBUTION.

Generally speaking, the overhead distribution can be divided into two classes—alternating-current lighting and motor

FIG. 20.—TRANSFORMER STATION P, ILLUSTRATING TYPICAL SUBSTATION BUILDING.

circuits and direct-current series-arc circuits. The city has been divided into numerous sections, the location of which is governed by load centers. At each of the load centers a distributing or substation has been erected, from which alternating-current circuits radiate. In the underground district cable feeders are run from the generating and substations to junction boxes, conveniently located, from which mains radiate and to which the various consumers are connected. Some of the large

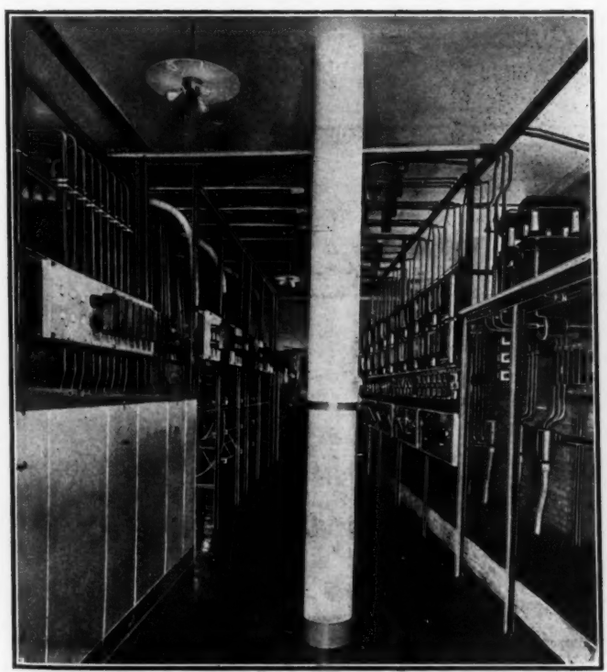


FIG. 21.—BASEMENT OF STATION P.

consumers have feeders running directly from one or more substations as well as connections to the street service mains. The standard type of manhole used in the underground district is shown in Fig. 26. The company owns approximately 650 miles of pole lines. The poles are of chestnut exclusively, and are purchased under rigid specifications, having in all cases an 8-in. top, the butt measurement depending on the size of the pole. No poles are set which are less than 40 ft. long, and the average length of span is 120 ft. The method of running services to individual houses in residential sections is shown in Fig. 29. The plan is to tap the lines on poles on side streets and continue the circuits along the backs of the houses in a sub-

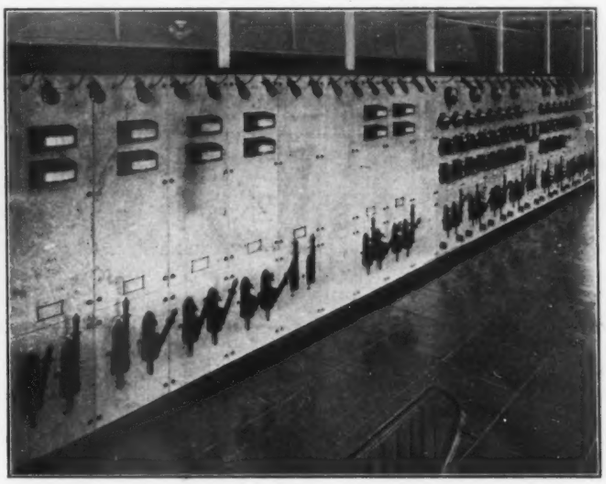


FIG. 22.—CONTROL BOARD, STATION P.

stantial manner. This makes it unnecessary to erect poles in the back yards and also shortens the length of the service leads.

STREET LIGHTING.

There are more than 12,000 arc lamps covering the entire area of the city. The distance between the lamps varies with the location; in the central portion of the city the lamps are located approximately 200 ft. apart, and this distance is increased in suburban districts to 400 ft. or 500 ft. The series-arc lighting system, which includes all the street lamps and a considerable portion of the commercial lamps, is made up of 9.6-amp, constant-current, open-arc lamps. This service is fur-

FIG. 23.—AUTOMATIC REGULATORS IN STATION P.

nished from five stations located in various parts of the city and the energy for which is supplied by 125-light Brush arc machines. About one-third of the machines are driven by synchronous motors, and the remaining machines are steam driven. It is expected shortly to operate all the arc machines by means of motors. The arc circuits are made up of groups

of 125 lamps, the layout of the system being so arranged as to minimize the amount of wire and also to readily locate trouble.

BUSINESS-GETTING AND BUSINESS-BUILDING METHODS.

For the purpose of facilitating the work of the commercial department the city is divided into districts, each district being

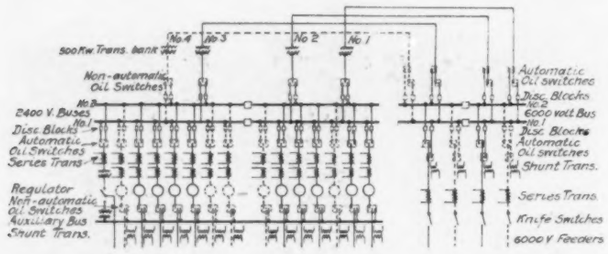


FIG. 24.—DIAGRAM OF ELECTRICAL CONNECTIONS IN STATION P.

supervised by a district manager, who is responsible to the general agent for new business. The district manager has under his supervision the obtaining of new business and the retaining of old business, collections, attention to complaints and all other matters pertaining to the district, subject to the central authorities.

The solicitors are assigned to the several districts according to their size and importance. A further subdivision is made by allotting sub-districts to solicitors. The solicitors meet with the district manager each morning and receive the work for the day. Card reports of every visit are made and through the medium of a daily report the work of the solicitor is carefully followed. These reports are submitted to the district manager and a record made and passed on to the main office, where they are further examined and filed in a card cabinet for ready reference.

The district solicitors are in constant communication with architects, builders and real-estate operators. Bulletins are issued daily from the general agent to the district office announcing building and real-estate operations. This bulletin is a summation of the knowledge obtained from construction reports received from various sources. Special departments, such as electric sign, exhibition and power, have been organized to assist the general soliciting force in obtaining business. If the case under consideration requires special attention, as for instance, engineering negotiations, formal proposals, meetings with committees and boards, the matter is handled under the immediate direction and co-operation of the general agent through the special departments. Solicitors are instructed in the essentials of the business by means of special instruction, temporary transfer to meter and electrical departments, and

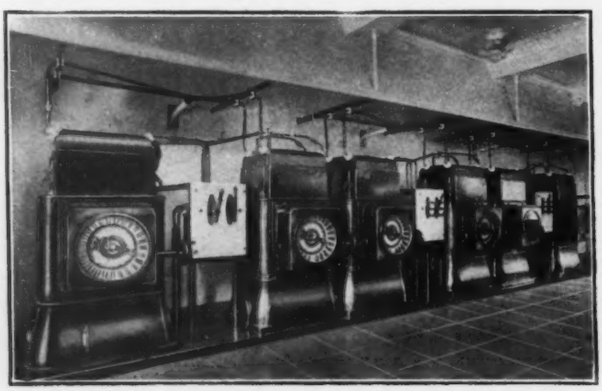


FIG. 25.—STEP-DOWN AIR-BLAST TRANSFORMERS IN STATION P.

through meetings of the various technical organizations within the company. In this way the solicitor becomes familiar with the conditions relating to the business.

The electric sign department is especially equipped to negotiate for sign business. Until recently the city ordinance restricted the placing of signs over the pavement. This restriction has very much hampered the work of the department. Under the new ordinance there is practically no limit as to the size of length of sign, and there is no doubt but that considerable business will result. Though hampered by the restric-

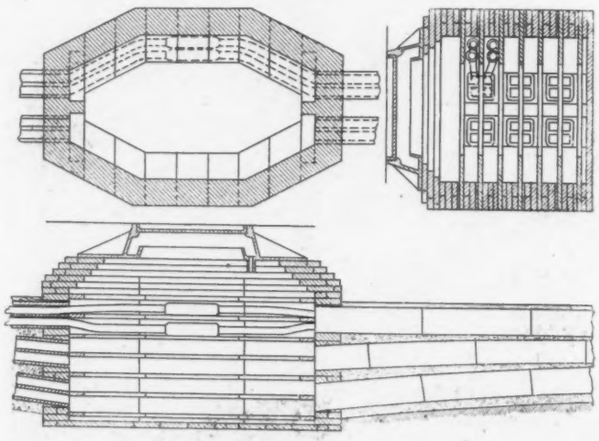


FIG. 26.—STANDARD MANHOLE CONSTRUCTION.

tions, the company has succeeded in building up a large sign business, particularly in the central part of the city.

The exhibition department is well prepared to assist the solicitors in exhibitions and demonstrations of any character. The main showrooms are located in the main office building, 1000 Chestnut Street. On the first floor, main entrance, is a large display-room for lighting and small heating, lighting and power appliances. In the basement, immediately below the showroom, may be seen an elaborate equipment of motor-driven appliances. All the apparatus in the display-rooms is operative. A complete photometer room is provided for testing lamps and demonstrating the use of lamps and shades. The photometer is equipped with modern testing instruments for the purpose of showing to present and prospective consumers the relative merits of lamps and all lighting appliances.

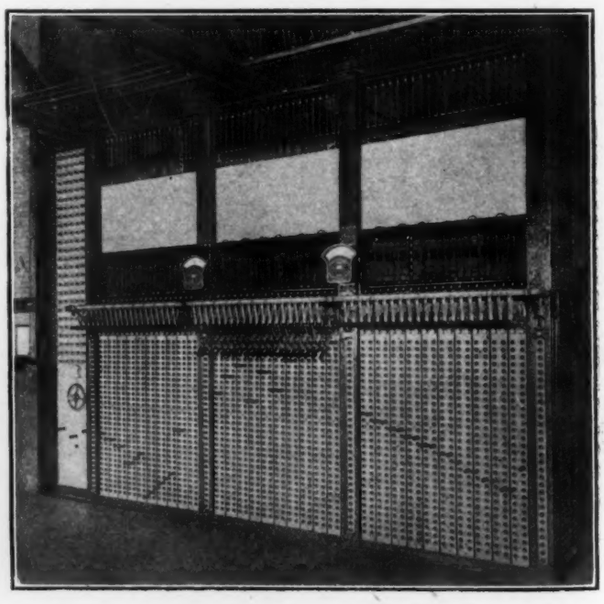


FIG. 27.—TYPICAL ARC CIRCUIT BOARD.

The power department was organized especially to deal with those cases involving special features and to encourage the use of electricity in the many manufacturing plants throughout the city, for new-building operations, refrigeration work and any special electrical application; and further to assist the district

manager or solicitor in obtaining new or retaining old business. This department associates with the architect and consulting engineer whenever required, and assists the manufacturer who cannot afford an expenditure for expert advice. Whenever necessary the full resources of the engineering and commercial

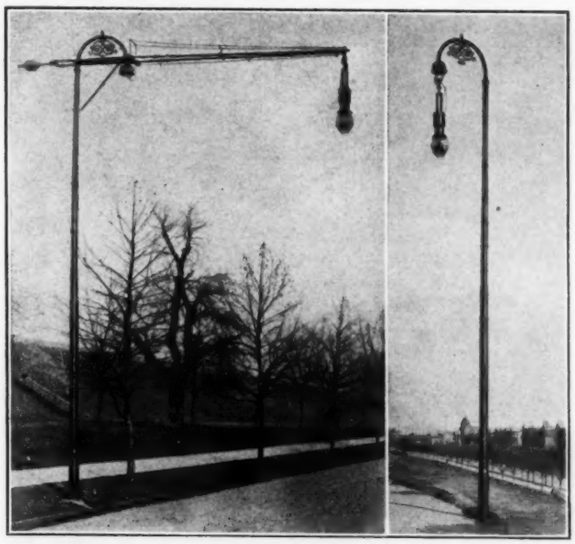


FIG. 28.—STANDARD POSTS FOR PUBLIC STREET LIGHTING.

departments are readily obtained for the purpose of developing and concluding any particular field of endeavor.

A commercial inspection department investigates the com-

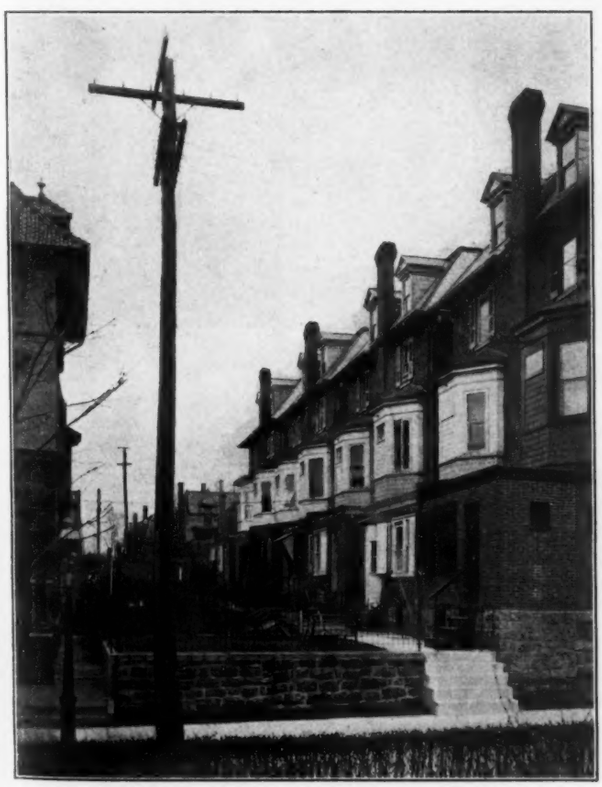


FIG. 29.—BACK YARD DISTRIBUTION IN RESIDENTIAL SECTION.

mercial features particularly with reference to the cause for complaint of high bills. This department is under the direction of the district manager and is in charge of a competent commercial man, who makes a special study of lighting effects, and assisted by the power department gives consideration to the proper distribution of motors. The company is always on the alert to suggest to the consumer changes that will tend to reduce the cost of electric service.

The Philadelphia Electric Company is not only an extensive user of electric vehicles itself; but also a promoter of this type of automobile. In order to encourage a greater use of electric cars, the company furnishes electrical energy for charging automobile batteries at reduced rates, the only restriction being that the owner may not charge batteries between the hours of 4 and 7 p. m. during the winter months. A customer who has his own garage and charging set and who is using electricity in his house, need not have a separate meter, and may earn a low rate under the regular schedule without restriction as to hours of charging. At these rates the ordinary monthly charge for operating automobiles will average less than $10.

The demands of the public, the establishment of sanitary laws and the enactment of pure food laws have brought about a condition which makes the establishment of mechanical refrigeration machines a necessity from the standpoint of cleanliness, economy and all-around utility. The cost of electricity to operate a refrigerating machine is frequently very much lower than the cost of an equivalent refrigeration by means of ice. The

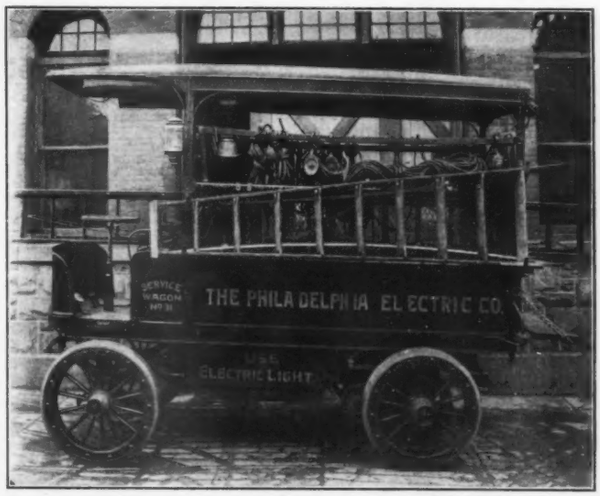


FIG. 30.—ELECTRIC-SERVICE AUTOMOBILE.

other advantages are so manifest that numerous installations have been and are being made in this city. The company has 62 refrigerating plants on its circuits, varying in output from ¼ ton to 35 tons, and representing 497 tons of refrigeration. A special department is maintained to take care of the refrigeration business, to answer all inquiries and to furnish necessary data in the way of cost of installation and operation.

The company has given free renewals of standard lamps for many years to those of its customers who use electricity from its mains exclusively. Tantalum and tungsten lamps are sold to customers at less than market price, and this charge for both purchase and renewals is considerably lower than the figure which represents the difference between the cost of the standard carbon-filament lamp and the new lamp. Tantalum lamps have heretofore been sold and renewed at a cost of 30 cents. A reduction in price for both the installation and renewal of this type to 25 cents is now announced. The cost of the tungsten lamp, for both installation and renewal, is considerably higher than the tantalum lamp. Special prices for tungsten lamps are made to those who use electricity exclusively from the company's circuits, and customers are urged to take advantage of the economies placed at their disposal.

The company has advertised extensively through the newspapers, its company bulletin and by means of circulars, pamphlets, etc. It endeavors to be continually in the minds of the public and to persuade them that its product will meet their requirements.

Lighting Conditions at Atlantic City.

CHANGES WHICH HAVE BEEN MADE AT THIS SEASIDE RESORT SINCE THE LAST CONVENTION

THE name Atlantic City is so inseparably connected with the idea of a summer resort that few realize that this "City by the Sea" has a permanent population of over 40,000 inhabitants. During the summer season it is estimated that as many as 4,000,000 people promenade on the city's famous Boardwalk. The necessity for catering to the demands of this army of pleasure seekers has given rise to the permanent settlement which makes up the city; for little, if any, manufacturing is done. The city is primarily a health and pleasure resort, and to add to the pleasure of a holiday or to ease the burden of care is the study and aim of those upon whom the reputation of the city depends. During the past few years comprehensive and well-matured plans have been laid looking toward the general beautification of the city and

FIG. 1.—ARC POST AND STANDARD USED ON ATLANTIC AVENUE.

the elimination of the essentially flimsy and temporary features characteristic of summer resorts. Some of the schemes laid out have already been executed, such as the paving of the streets and the illumination of the city's principal thoroughfare, Atlantic Avenue.

Electricity for public and private uses is furnished by the Atlantic City Electric Company, whose station adjoins the tracks of the Pennsylvania Railroad Company. The building houses 1400 kw in direct-current machinery and 2690 kw in alternating-current apparatus. The direct-current apparatus comprises three Fort Wayne three-wire machines, one rated at 600 kw and driven by a Wetherill engine and the other two rated at 400 kw and driven by cross-compound Allis-Chalmers engines. There are nine 125-cycle, single-phase alternators of General Electric, Stanley and Westinghouse make feeding the alternating-current lines. The boiler equipment comprises 2820 hp in Edgemoor water-tube boilers fitted with Jones under-feed stokers; 1200 hp in double-deck return-tubular boilers and 1400 hp in single-deck return-tubular boilers. Feed water is obtained from a driven well 850 ft. deep. The boilers fitted with stokers operate under forced draft, the equipment being built by the American Blower Company. The fuel used is a mixture of bituminous and anthracite screenings, the proportions used depending on load conditions. Ordinarily four parts of anthracite screenings are used with one of bituminous. The latter costs about $3.20 per ton, while the prices paid for screenings are $1.50, $1.90 and $2, depending on the mines from which they are received.

At present all the circuits are run overhead, but work will soon be started on some underground work on Atlantic Avenue and also on the Boardwalk. Four blocks of underground conduit will be laid on Atlantic Avenue and for 11 blocks the circuits now overhead on the Boardwalk will be transferred and fed from cables placed under the deck of the walk. All of the lamp circuits will be fed from four-wire, three-phase cables, while the motor circuits will still be fed from the direct-current mains. Atlantic City at present relies entirely upon surface

FIG. 2.—PORTION OF THE BOARDWALK BY NIGHT.

drainage to carry off the rainfall, and inasmuch as the city is built on sand, water is found not far from the surface. For this reason water-tight underground work is out of the question and the company will use lead-covered cables and will install them under the presumption that they will generally be under water.

A new generating system will shortly be installed at Atlantic City, but whether the station will be built somewhere else or at the present site utilized has not yet been definitely determined. At any rate, a 60-cycle, three-phase system will take the place of the present 125-cycle, single-phase system and possibly exhaust-steam turbines will be used in conjunction with whatever type of prime mover will be installed. The company has quite a steam-heating load; enough, in fact, to use all the exhaust steam available. This heating season extends over eight months of the year. The plant operates non-condensing and in summer when the lighting load is heaviest and the heating load nil, the exhaust steam will be used to drive low-pressure turbines. During the heating season the low-pressure turbines will be cut out of service.

The connected load at present fed from the station is approximately 6100 kw, including 800 series arcs and 1974 kw in motors. All the buildings being above ground—that is, without

basements, and most of them being residences—the day load is not very large, the average for the year being 600 kw. The base rate for lighting circuits is 16 cents per kw-hour, subject to a discount, which is as high as 50 per cent, based on the consumption and length of contract. The base rate applies more particularly to those residences which are only open two or three months during the summer. Large consumers of energy are given a special rate which is considerably lower than the rates quoted above. The heating mains extend for a total distance of seven miles. The two-pipe hot-water system is employed and the rate is 20 cents per square foot of radiating surface.

FIG. 3.—ATLANTIC AVENUE BY NIGHT, SHOWING TOWER OF CITY HALL.

The company has pushed the tungsten lamp energetically and has a great number connected both on flat rate and on meter basis. There are approximately 2500 tungsten lamps connected on a flat rate. The bulk of the lamps are rated at 100 watts and burn from one-half hour after sunset to midnight. The rate for these is $2 per month each. The flat rate only applies where the lamp is visible to the company's inspectors. A patrol system is maintained on the tungsten flat-rate circuits so that undue advantage is not taken of the company. The tungstens are sold for cost to those consumers who burn them on metered circuits.

Although the Boardwalk is more widely known by visitors, the principal thoroughfare and the one most frequented by the residents of Atlantic City is Atlantic Avenue. The general beautification plan of the city called for paving this street and also illuminating it with ornate arc posts and standards. Unfortunately this work was entrusted to an architect, so that while architecturally the posts and standards may leave little to be desired, from an illuminating viewpoint they are very faulty. Reference to Fig. 1 will show wherein these lighting fixtures are lacking. The heavy iron lyre in which the arc is placed casts a perceptible shadow and the ribs in the lantern also interfere with the distribution of the light from the incandescent lamps. There are 38 blocks on Atlantic Avenue illuminated by means of these fixtures, or three miles of thoroughfare. Two arcs are placed at diagonal corners and three standards are placed on each side of the block and spaced 95 ft. apart. The posts are 30 ft. high to the pinnacle and the standards are 12 ft. 3¼ in. high from the sidewalk. Besides the arc at the top of the post there are 12 25-watt tungsten lamps in the lantern further down and eight 8-cp lamps in the street markers. The standards have six 25-watt tungsten lamps in the lantern. The posts are of cast iron, and the lanterns and street markers are of bronze. In all there are 77 arc posts and 201 standards and the cost erected was $44,000. The complete scheme of illumination on the avenue provides for an arc lamp at each corner, and the lantern being as high as the lanterns on the standards, festooned incandescent lamps will be strung along the avenue from lantern to lantern on special occasions. At present the lamp-posts and standards are fed from overhead wires. Two of the illustrations herewith show the appearance of these fixtures at night. The City Hall, on this avenue adjacent to the Pennsylvania Railroad station, has received a generous treatment of outline lighting and is clearly shown in one of the views.

The Boardwalk is at present lighted by arc lamps along the outer edge of the walk and by festoons of incandescent lamps. The walk is 60 ft. wide and four miles long, and besides the arc lamps at each street intersection, there are upward of 10,000 incandescent lamps in the festoons. A small stretch of the walk is shown in Fig. 2, and illustrates the general scheme of lighting which has already been described in detail in our columns. The lamps used are frosted and are rated at 4 cp with a 25-cp lamp in the center of the festoon. When the festoons were erected four summers ago it was only expected that they would be used for a few months, and being erected in a hurry no extra care looking toward permanency was taken. The scheme has weathered the storms of three years, however, which is surprising in view of the light construction. Actual use has shown that for cheapness and reliability the plan of lighting is without a peer.

FIG. 4.—LOOKING DOWN ATLANTIC AVENUE, SHOWING LIGHTED ARCS AND STANDARDS.

The growth in size and elaborateness of the electric sign is nowhere so well shown as on the Boardwalk. Although aggressively conspicuous and always commercial, the signs do not mar, but rather add to the attractiveness of the walk. In the

April 1 issue several of these signs were illustrated and described. Since then a number of others have been erected by the Valentine Electric Sign Company and these are illustrated herewith. The sign load on the Boardwalk approximates 500 kw, and it is interesting to note that because of climatic conditions and the action of the salt water, it is necessary to rebuild the signs every two years. The sign shown in Fig. 5 is one of the largest at present erected and is intended to show a water-fall effect with surrounding scenery of rocks, trees, etc. The sign is 75 ft. long and 72 ft. high. The water-fall effect is worked over a space of 54 ft. wide and 23 ft. high and this section is operated by means of a gravity flasher of 36 points operating about 1700 lamps. The letters in the word "Clysmic" above the water-fall range from 8 ft. to 14 ft. in height and together with the words "sparkling" and "king of table waters" burn steadily. The trees are lighted by means of lamps set at irregular points and the color effect is produced by color caps. The rocks, etc., are lighted from reflectors. The entire sign contains about 2400 lamps ranging in rating from 2 cp to 32 cp and divided on approximately 75 circuits.

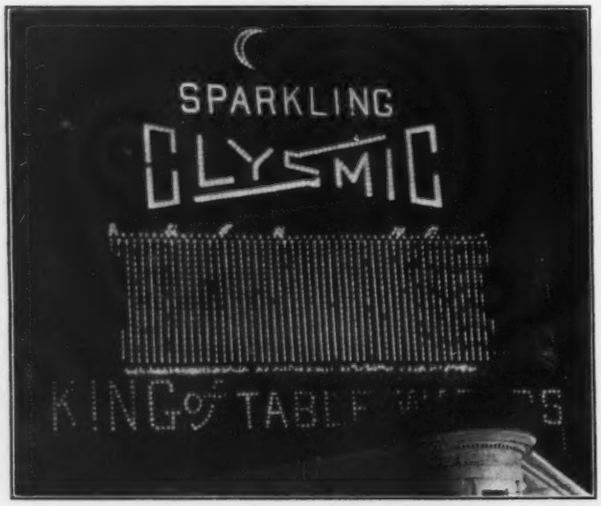


FIG. 5.—SIGN GIVING WATER-FALL EFFECT.

FIG. 6.—SIGN WITH SKYROCKET EFFECT.

The sign shown in Fig. 6, while much smaller than the one described above, is located on the reverse side of it and is quite as attractive. A rocket effect shooting 50 ft. or more into the air breaks in a series of vari-colored stars and showers of light which pour down over the reading matter of the sign, which reading matter appears as the shower disappears. The sign is 18 ft. x 30 ft., and contains about 800 lamps operated by a combination flasher. Over 1000 lamps are in circuit on the sign shown in Fig. 7. The sign occupies a space 36 ft. x 36 ft., and the various parts flash successively, the border flashing continuously in such a way that it has the appearance of gradually shunting around from place to place. All the color effects are produced by means of various tinted paints and color caps. The lamps are all rated at 2 cp. The relative size of the signs can be estimated from the view of the Boardwalk; the sign in the background faintly visible is 60 ft. x 90 ft. and is located about a mile below the sign shown in the foreground.

Plans have been prepared for beautifying the Boardwalk in the near future just so soon as more needed improvements have been made elsewhere in the city. The scheme provides for widening the walk to 100 ft. and illuminating it by rows of standards spaced 20 ft. from each side of the walk and 20 ft. apart. At street intersections five ornate arc lamp posts will be placed, one at each corner and one in the center. The standards will have clusters of incandescent lamps and festoons of incandescent lamps will be looped from standard to standard.

FIG. 7.—FLASHER SIGN ON BOARDWALK.

Projecting into the ocean from the Boardwalk are a number of steel and concrete piers. All of these are outlined with lamps and the Million Dollar Pier, in particular, is brilliantly and attractively lighted within. The latter pier is connected to the circuits of the Atlantic City Light Company and the connected load during conventions is as high as 350 kw. The company has also made a contract to light the Steel Pier, the connected load approximating 350 kw. Almost all of the large hotels on the Boardwalk have isolated plants, the exhaust steam from which is used for baths and heating purposes. Breakdown connections are had with the lighting company, however.

A feature of the lighting situation at Atlantic City is the war between the rival gas companies which has lasted for months and has resulted in slashing of rates, free piping, free fixtures, free mantles and in a number of cases free gas for a limited period. The new company, Consumers' Gas & Fuel Company, sells gas at 90 cents per 1000 cu. ft., and since October the older company, the Atlantic City Gas & Water Company, is offering gas with the inducements mentioned at 50 cents per 1000 cu. ft. This has in a measure reacted on the electric light company, since those consumers which have both gas and electricity used more gas and less electricity during the past winter because of the extra heat obtained. The electric light company has, however, not lost any customers, and what with new patrons manages to keep its output up to normal.

Operating Features of Various Generating Systems.

ORGANIZATION OF OPERATING FORCES AND CONTROL OF APPARATUS IN EMERGENCIES.

IT is admitted that an efficient operating force is as essential to an electric light company as an economical generating station, and that a plant with mediocre equipment but excellent organization can give as good service, if not better, than a superior outfit operated by a less proficient staff. The larger the station, the greater the need for organization and system, and the more reliable must the service be. Continuity of service at all hazards has been the aim of every large company, and since all generating, controlling and distributing apparatus is vulnerable, it is interesting to note what elaborate precautions have been taken to protect the consumer from the effects of mishaps at the generating end of the system. The organization of the operating forces, their control under ordinary working conditions, their direction in emergencies and the manipulation of the apparatus in the stations are also matters of more than passing moment. For these and other reasons the accounts of operating conditions in large and small cities which follow should be of interest to operating engineers and managers, since they show what has been accomplished and may indicate what can be done along similar lines even in smaller plants.

Operation of the Boston Edison Company's L Street Station.

THE Edison Electric Illuminating Company, of Boston, operates the largest central-station plant and distribution system in New England. The company now supplies 31 cities and towns with electrical energy, serving an area of 466 sq. miles and a population of about 1,250,000. The point most remote from the main generating plant is Hopkinton, 43 miles southwest of the station. During the past five years the company's lines have been pushed farther and farther into the suburban and semi-rural districts of eastern Massachusetts, in accordance with a policy of eliminating the relatively inefficient stations of small capacity scattered throughout the different communities, generating practically the entire energy consumed at a plant of the most modern design located on the waterside at Boston and distributing from the former steam stations of local companies as substations. Increased economy and reliability of service have been the natural result of the company's expansion.

The entire alternating-current output of the company is now, or will shortly be, generated at the L Street station in South Boston. This is the largest power plant in New England, and it is the center of operating control for the system. The business district of the Boston direct-current district is at present mainly supplied from another power plant of the company, located on the Atlantic Avenue waterfront, in the midst of the business section of the city. Although this station is a plan of modern design, motor-generator sets have been installed at this point, which will enable more or less of the direct-current load to be thrown upon the L Street station, leaving a considerable part of the Atlantic Avenue equipment available as reserve capacity. A large capacity in storage batteries is also available in Boston for emergency and general peak service.

FIG. 2.—TYPICAL BOILER-ROOM AISLE.

The operating features of the L Street plant illustrate the care which the company takes to maintain absolutely reliable service without sacrifice of production efficiency. This station is located about two miles from the business center and is connected with the various distributing points on the system by inter-station transmission lines of both underground and overhead type, arranged to provide for continuous service under all anticipated conditions of operation. The outlying stations are supplied with three-phase, 6900-volt service, and the urban

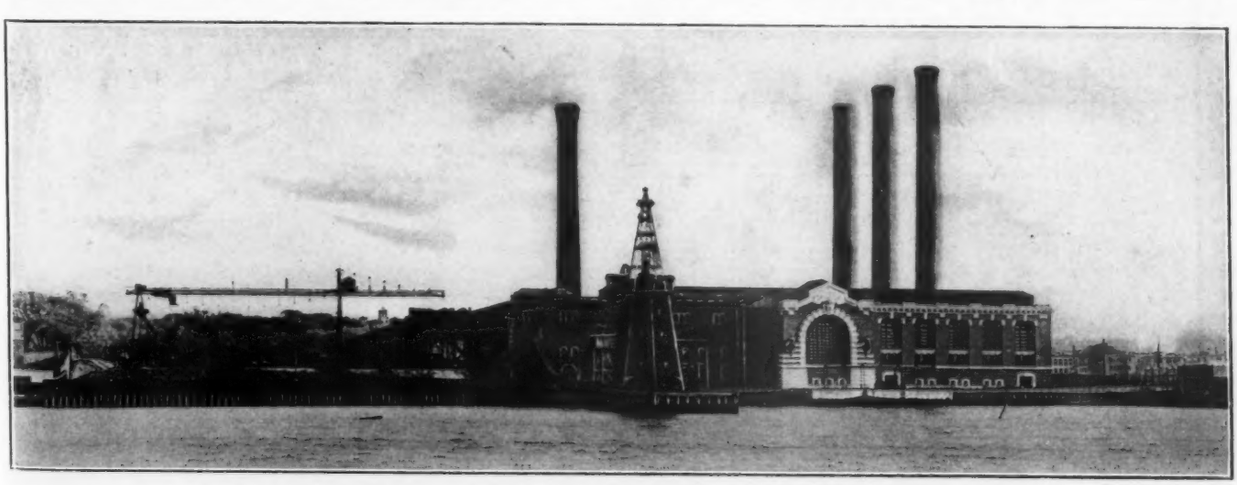


FIG. 1.—EXTERIOR VIEW OF L STREET STATION, COAL-HOISTING PLANT IN FOREGROUND.

alternating-current service is handled by 2300-volt, three-phase lines, a few of the nearer substations being temporarily supplied with 4600-volt service. A general diagram of the system is shown herewith, three-phase lines for supply and tie service being indicated for the sake of simplicity as single lines. In general, each substation is provided with an operating and an auxiliary bus, and has at least two different methods of connection with the generating station. A full description of the methods of handling the distribution system has been mentioned in a previous issue.

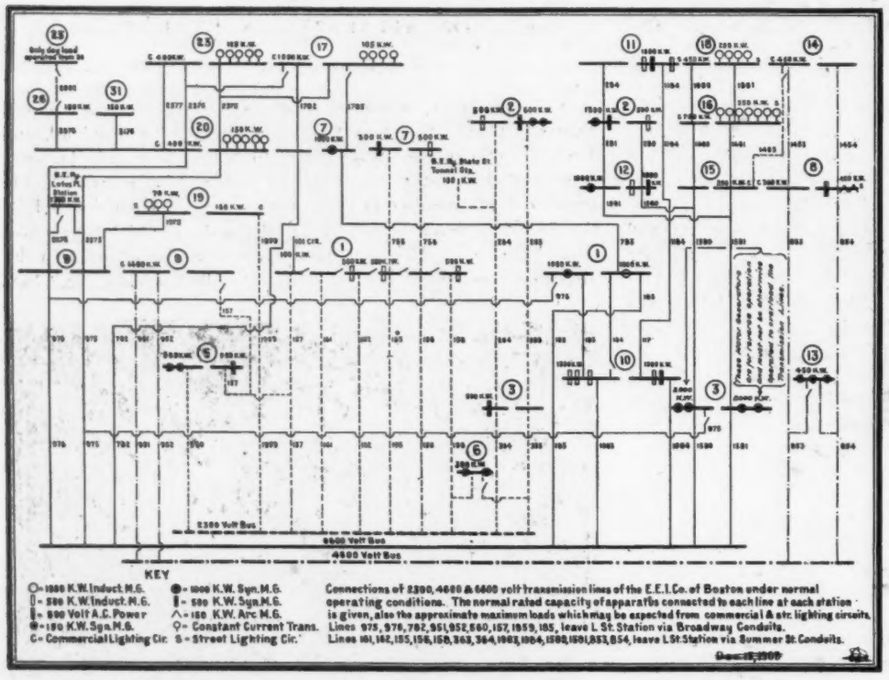


FIG. 3.—GENERAL DIAGRAM, BOSTON EDISON ALTERNATING-CURRENT SYSTEM.

The L Street plant consists essentially of two separate stations so far as the buildings and generating apparatus are concerned. The two divisions of the plant are officially designated at station 4-1 and station 4-2, but they are electrically connected through suitable transforming and switching apparatus to serve the alternating-current system in common. The two stations are of radically different types, representative of the state of the art of design at the periods of their respective construction. Station 4-1 at present contains 12 Babcock & Wilcox boilers rated at 550 hp each, operated at 160-lb. steam pressure, and supplying six 1500-kw, 2300-volt, three-phase, 60-cycle General Electric revolving field alternators direct driven by vertical cross-compound McIntosh & Seymour engines. The boilers in station 4-1 are equipped with Hawley down-draft furnaces, hand fired. Natural draft is provided by a brick chimney 225 ft. high and 11 ft. 6 in. inside diameter. City water is used for boiler supply in station 4-1, the feed-pump installation consisting of three 8-in. x 10-in. motor-driven Goulds triplex pumps. The pump speed is 32 r.p.m. and each unit has a capacity of 208 gal. per minute against 160-lb. boiler pressure. There are 12 National feed-water heaters in this station, each being of the vertical type, with 750 sq. ft. of heating surface. One heater per engine unit is arranged to take the exhaust steam and a second is piped to receive the air-pump exhaust. The feed-water in this station enters the boilers at about 190 deg. Fahr. Each engine is provided with a Blake vertical, twin-jet condenser and air pump. A 4500-ton coal bunker is installed above the boilers. In the engine-room of the 4-1 station are installed 40 Brush arc generators of 6.6 amp capacity direct-connected in pairs to 200-hp, 2300-volt, three-phase synchronous motors, for supplying the street-light-

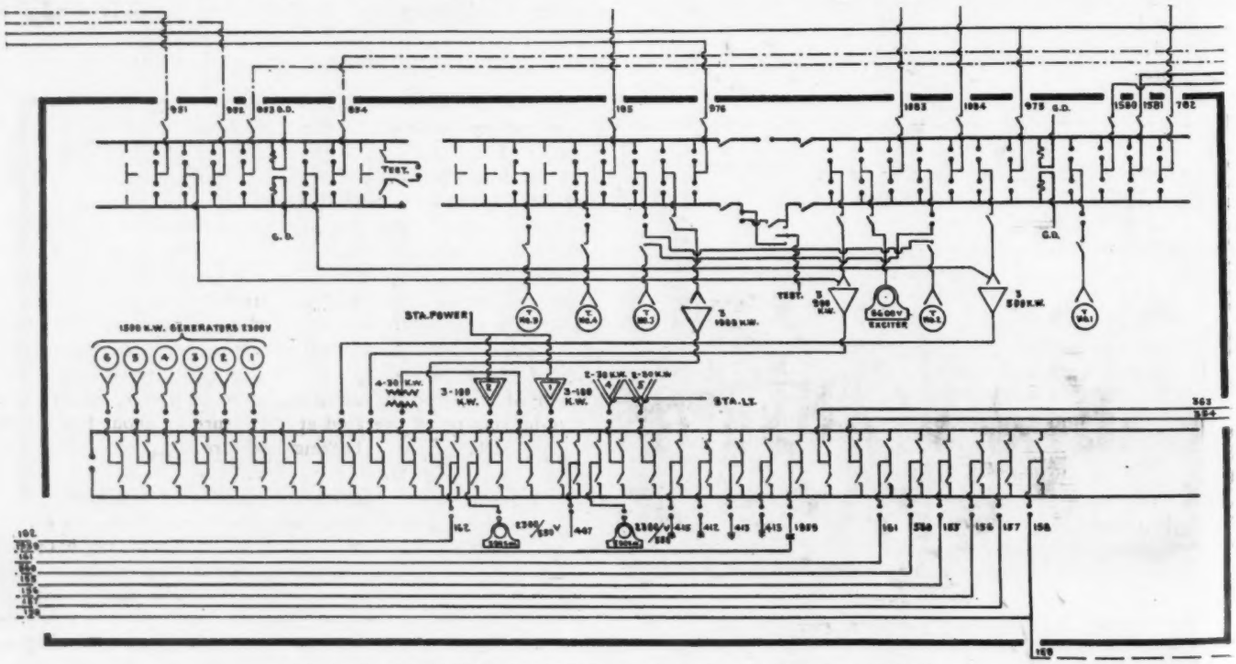


FIG. 4.—L STREET STATION BUSBAR, GENERATOR AND LINE CONNECTIONS.

ing service of the city of Boston. There are also installed on this floor one 150-kw and two 500-kw, 2200-volt to 550-volt motor-generator sets for supplying energy to motor-driven

station auxiliaries and to certain lines of the Boston Elevated Railway Company. The 75-kw motor-driven and one 50-kw, 125-volt engine-driven exciter sets are installed in the engine-room, these, in connection with a 150-kw motor-driven unit in the 4-2 station, furnishing the excitation for the entire L Street plant. In addition a storage battery of 1048-amp

FIG. 5.—BOSTON EDISON COAL FIELD AND BRIDGE, L STREET STATION.

capacity for one hour at 125 volts is installed in a separate building adjoining the station, and kept floating on the exciter bus at all times.

There are two switchboards in station 4-1, one on the engine-room floor and for the arc service, and the other on a gallery immediately above, devoted to the generators, exciters, motor-generators, transformers and 2300-volt service. These boards are of the panel type, equipped with manually operated apparatus in the main. The accompanying drawing (Fig. 4) shows the generator, transformer and busbar switching arrangements in both divisions of the L Street station.

Station 4-2 is at present undergoing a change in the size of its electrical generating machinery. At the December peak, in 1908, there were available four units of 5000-kw capacity each and one 8000-kw unit, all being Curtis-General Electric turbo-alternators. Two of the 5000-kw units are now being replaced by 8000-kw sets, so that by the fall of this year the electrical generating plant at L Street station 2 will consist of two 5000-kw and three 8000-kw turbines of three-phase, 60-cycle, 6900-volt design. The steam for these machines will be supplied by the present installation of boilers, which consists of 36 Babcock & Wilcox units of 512 hp each, set in five rows of batteries. Station 4-2 is built on the unit principle, with separate boiler

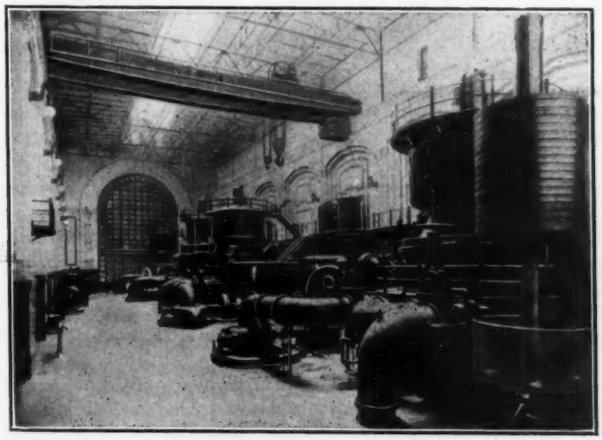


FIG. 6.—TURBINE PLANT, L STREET STATION.

batteries and auxiliaries for each turbine. The operating steam pressure is 175 lb., and the boilers are equipped with Roney stokers. The new turbines are five-stage machines. Each turbine is supplied with steam through a line which increases in size from 8 in. to 14 in. as it passes across the rows of boilers corresponding to the turbine. The different turbine steam lines are tied together by 10-in. connections, with appropriate valves to provide for emergency service in case of trouble on any steam line. These valves are electrically operated, controlling switch boxes being installed at convenient points in the boiler-room. The 8000-kw units have a continuous capacity of 12,000 kw each. The boilers are supplied with feed water by an installation of five Worthington 17-in. x 12-in. x 15-in. horizontal duplex pumps having a capacity of 308 gal. per minute each. The 8000-kw turbine at present installed has a feed pump of the same make, the size being 20 in. x 14 in. x 15 in.

In station 4-2 are installed four vertical feed-water heaters of National make, each having 1600 sq. ft. of heating surface. The feed water is raised to about 200 deg. Fahr. before it enters the boilers. Natural draft is relied upon as in the first division of the station, there being three Custodis brick stacks in service. Each is 250 ft. high and 16 ft. in inside diameter; there are no economizers in either section of the station. The turbines are operated at from 150 to 160 deg. Fahr. superheat. On account of the favorable showing made by the company's steam-turbine equipment, there exists to-day at L Street a considerable reserve boiler capacity, so that it will not be necessary to install additional boilers in connection with the turbine changes now in process. On the normal station peak a load of 1500 kw per 500-hp boiler is carried. At present all 12 boilers of station 4-1

FIG. 7.—OPERATING ROOM, L STREET STATION.

are operated on a single stack. Sixteen, 12 and 8 boilers are operated independently on the separate stacks of the second division of the L Street plant. No provision was made in the station design for operating on different stacks, a separated plan of working being considered better.

Each of the 5000-kw turbines is provided with a Worthington surface-condensing outfit, including a 10-in. x 24-in. x 18-in. steam-driven dry-air pump; a 4-in. centrifugal wet-vacuum pump of the two-stage pattern, direct driven at 1200 r.p.m. by a 10-hp motor in two instances and a 15-hp motor in the other cases; and a 28-in. centrifugal circulating pump having a capacity of 18,000 gal. per minute, driven by a Harrisburg engine. Each of the 5000-kw units has a steam-driven, water-cooled step-bearing pump operated at a pressure of about 1100 lb. per square inch, giving a bearing pressure of about 800 lb. per square inch. The circulation water for the 8000-kw turbine is handled by a 30-in. steam-driven volute centrifugal pump. This unit has a centrifugal wet-vacuum pump, turbine driven, a 12-in. x 30-in. x 18-in. dry-vacuum pump, steam driven, and a 14-in. x 3½-in. x 15-in. horizontal duplex step-bearing pump. At the present writing the active turbine equipment in this station consists of one 8000-kw unit and two 5000-kw sets, a fourth 5000-kw set being held solely in reserve on account of its having one less stage than the others, and consequently being less economical in operation.

The company burns New River coal, approximately 90,000 tons per year being consumed at the L Street station, and about 15,000 tons elsewhere. The fuel is brought to the plant

by water and stored in a coal field having a capacity of 70,000 tons on the station property. An elaborate motor-driven conveying system is in service, including traveling belts between the wharf tower and the field, a bridge crane of the cantilever type for field service, and conveying equipment connecting the field with the two divisions of the station. The capacity of the belt conveyor installation is 400 tons per hour. It is operated only in the daytime, in view of the large storage capacity above mentioned. Coal analyses are made by the company's department of standardization and tests, samples being taken from barge loads and from the boiler-rooms. Above each boiler in the turbine station is a pocket having a capacity of 44 tons. Coal used in the engine station boiler-room is recorded by checking car weights as fired, and that used in the turbine fire-room is weighed by hopper scales located above the stoker spouts. The total weight of coal used by each division of the line number; thus, line 1959 runs from L Street to substation 19, Milton, the actual line number being 59.

The operating organization of the plant at L Street has been worked out with great care, and it is the result of long experience in handling the system under normal and emergency conditions. In the operating chart (Fig. 8) are shown in skeleton form the relations of the different officers and station attendants. The generating department deals with the expense of operation and also the repairs and renewals of all steam and electrical machinery and apparatus, including storage batteries, necessary to deliver to the busbars and switchboards the output of the generating system; the necessary distribution from substations and incidental office work. The head of the department has headquarters at the main offices of the company on Boylston Street, Boston, and is responsible for the administration of the physical generating and distribution plant, paying special con-

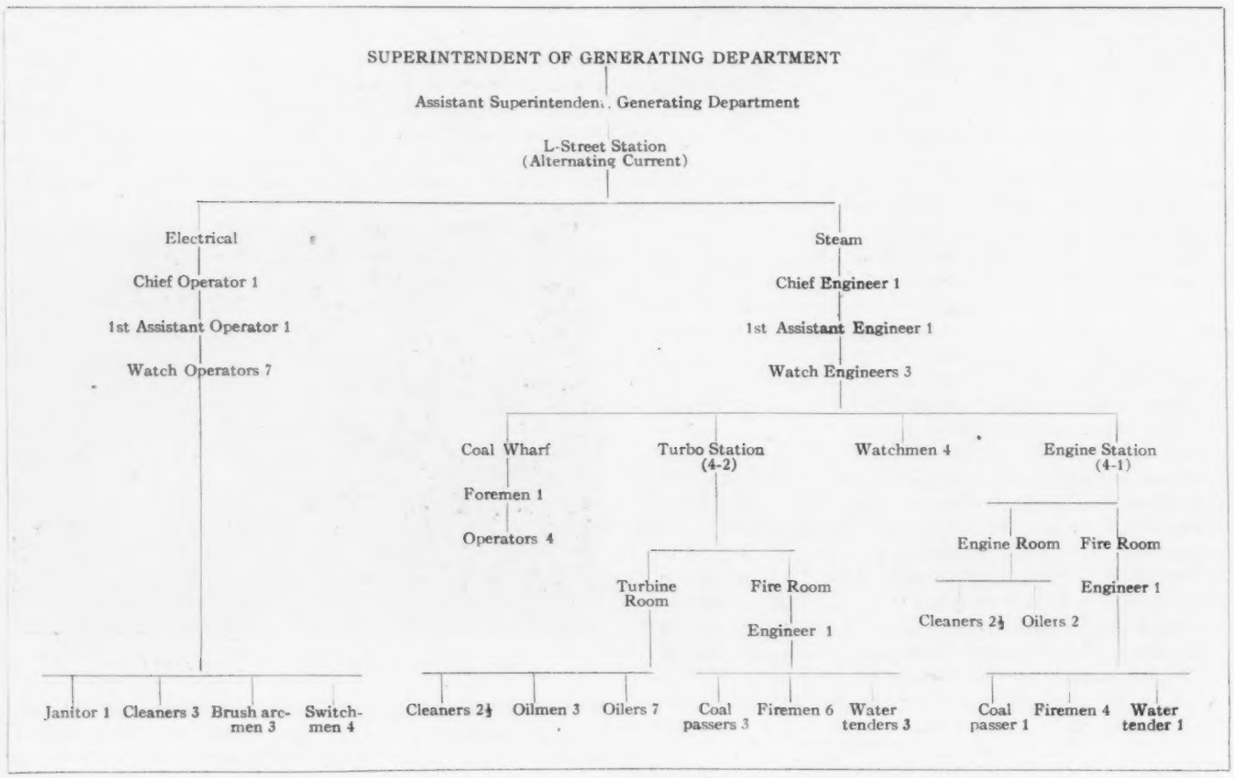


FIG. 8.—OPERATING CHART.

the plant is tabulated and sent to the office of the superintendent of generation daily, with other statistics to be outlined later.

The general scheme of wiring and busbar arrangement at the L Street plant is shown in the accompanying drawing. The switching apparatus of the turbine division of the station represents the latest type of remote-control equipment, a separate building being provided for all high-potential service. The operating center of the plant from the electrical point of view is a separate room between the turbine and the engine divisions of the station in which are concentrated the controlling and measuring apparatus in immediate connection with the turbine and transformer units, the possibilities in the way of connection being exceedingly flexible. In general, there are two sets of busbars, one for regular and the other for emergency operation. Each set is sectionalized horizontally, and any generator or feeder circuit can be thrown upon any busbar of the proper voltage, as well as any transmission circuit running from L Street to the company's substations. Provision is also made for tying corresponding sets of three-phase busbars together when necessary. In general, the scheme of transmission line numbering is such that the substation to which the line immediately connects can be seen in the first or first and second numerals of sideration to reliability and economy of service in all their aspects. Reporting to the superintendent of generation is an assistant superintendent, whose duties are essentially executing the orders of his superior, watching the instrumental accuracy and condition; keeping in touch with the load and its variations and the possibilities of economical handling of it in the system, supervision of the general handling of apparatus, analysis of operating results, studies of irregularities in the system and technical investigations leading toward the improvement of conditions, studies of labor requirements, and general supervision of all conditions affecting the reliable and efficient maintenance of service.

The L Street station is in general divided into an electrical organization and a steam organization, as shown. In brief, the work of the electrical division is to maintain a uniform pressure at the feeder terminals throughout the entire system; to load all machinery under its charge properly and economically, and to be responsible to the department for the welfare of all electrical machinery, which must at all times be, so far as possible, ready for operation. All the repairs except minor ones, in this division, are done by outside parties. The electrical operation is in immediate charge of a chief operator of long experience with

the company, who is constantly in touch with the system at all hours of the day and night, thoroughly acquainted with practical station service and in harmony with the plans of the department head. The duties of the chief operator cover a wide executive range, with the fundamental requirements of continuous and economical production as the standard of reference. Among the matters which are constantly before the chief operator are the loads distributed between the different portions of the electrical plant, the condition of all electrical apparatus from hour to hour, anticipation of variations in the demand of the system upon the generating plant, general regulation of the system, manner in which subordinate employees are performing their duties, co-operation with the chief engineer of the steam division to give the latter so far as possible advance notice of the probable demand for units, and maintenance of satisfactory service and contentment among the electrical personnel. Interpretation of periodical or casual instrumental records and the adjustment of the equipment to meet expected conditions with safety and efficiency are also functions discharged by the chief operator in the administration of the installation.

The assistant to the chief operator is required to occupy the post of the latter when necessary, being a first-class understudy. He must be familiar with the electrical apparatus of the entire system, and circulate among the different installations in generating and distributing service, noting any irregularity in the operation of the machinery or in the men on the different watches, and to keep his superior in touch with such details as do not come under the immediate notice of the latter. In cases of emergency the assistant chief operator goes at once to the station and stands ready to assist if needed.

The watch operators are men who have come up the line, and who understand all the electrical combinations which can be made with machines, switches and lines throughout the system. The watch operator in each shift and division of the station is in immediate charge of the electrical control of his section of the plant, and under him are switchboard men and cleaners. At L Street the operation of the engine station requires a more extended electrical organization than is needed in the handling of the turbo-alternators. On a given shift the turbine plant is handled by one operator at the switchboard in the main operating-room, with the watch operator in charge, who covers the two divisions of the station. The switchboard and Brush arc men indicated in the chart are mainly occupied in the engine station. The cleaning force carries on its work through the electrical plant as directed by the watch operator in charge at the time.

The steam organization at L Street is in charge of a chief engineer, who, like the chief electrical operator, is constantly on demand and continually in touch with the conditions at the station. The chief engineer is responsible to the head of the generating department or his representative for the satisfactory and efficient operation of the steam plant. He is of necessity a first-class mechanic with a wide experience in steam-power plant service, possessed of good disciplinary powers, and alert to exercise a broad supervision over the handling of all the equipment in the plant from the coal wharf to the generators. Economy of operation and reliability of service form the groundwork of this official's duties. In the steam division of the plant the chief engineer's responsibilities correspond to a large extent with those of the electrical operating chief, the two working hand in hand all the time to produce the best results.

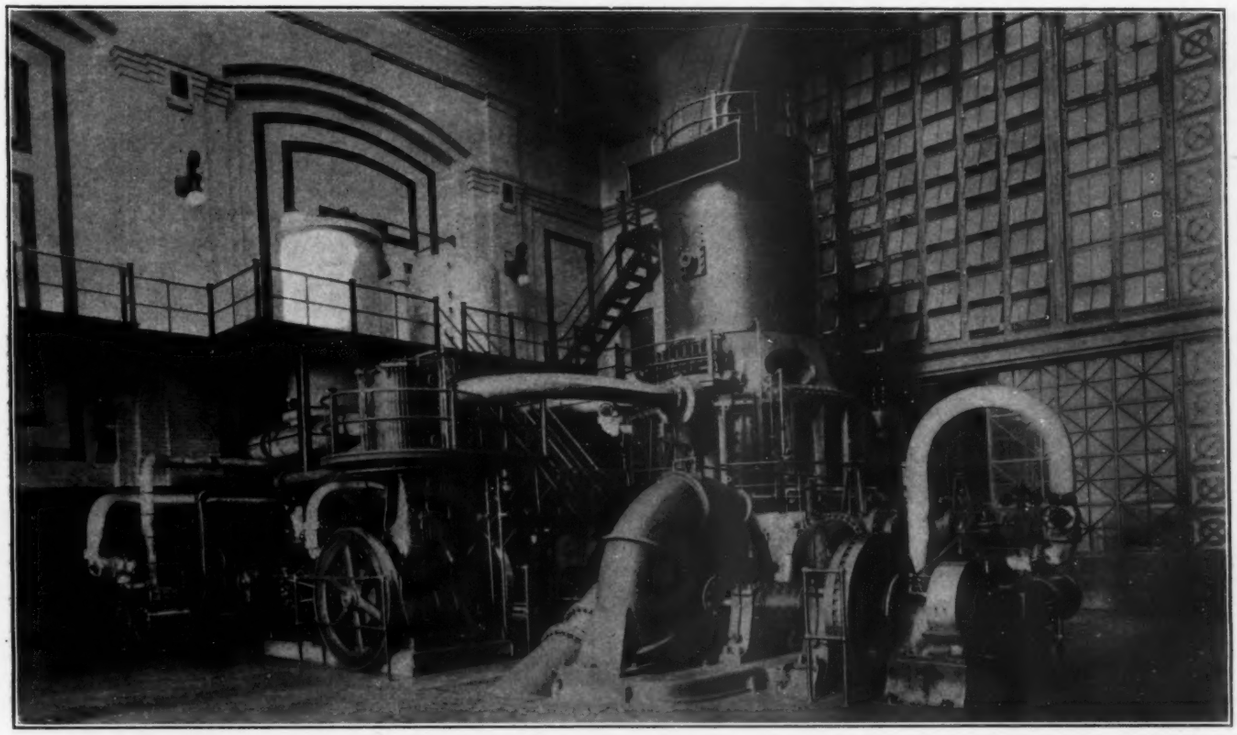


FIG. 9.—NEW 12,000-KW CURTIS TURBO-ALTERNATOR.

Reporting to the chief engineer is a first assistant engineer, corresponding to the assistant electrical operator. He is in immediate charge of the engine and turbine-rooms, and under him are the watch engineers, who, in the absence of the chief, have absolute control over every piece of steam apparatus from the ends of the crankshafts to the outer ends of the circulating water intake, including all labor incident to steam operation. The first assistant is primarily held responsible for economy of operation in both labor and material of the steam system. It is his duty to note and report to his chief any repairs needed, whether large or small, whether in the line of keying cranks or wrists, opening of cylinders, adjustment of pistons, packing leaky valves or glands, maintaining steam piping, supervising the water-line operation, the working of air and circulating pumps, jet and surface condensers, the undue consumption of cylinder or engine oil and waste, the operation of the oiling and step-bearing systems, dry-air and wet-vacuum pumps, number of boilers and quality of coal in use. He is required to instruct all the men in his charge regarding the working of all steam appa-

ratus on the system, and to oversee the conditions under which overtime may be needed. The watch engineers are required to perform as nearly as possible the duties of the first assistant engineer, particular reference being made to the keeping of all apparatus in prompt repair.

The oilers are required to keep the motive power in operation after the machinery has been started, and to know that the lubrication of each machine in service is being properly performed. In case of any irregularity in the operation of an engine or turbine, the oiler is required to give immediate notice to the watch engineer in charge. He is also required to see that his machinery does not use too much lubricant and when a unit goes off the line to wipe and clean it ready for the next run. The cleaners are general utility men, with special duties as indicated by their classification. They are in evidence not only to keep the apparatus in such condition as will render it attractive to the eye and efficient in service, but to render such assistance as may be required in the work of the watch engineers and their subordinates.

The boiler-rooms are each in charge of an engineer whose immediate superior is the engineer in charge of the watch. The boiler-room engineer carries a first-class engineer's license and is familiar with the manner in which the load rises and falls. He makes a special point of keeping in touch with the watch engineer and endeavors to know as far ahead as possible what the demands upon the station are going to be. Under the boiler-room engineer in each division come the kinds of repairs which are executed in the fireroom, including boilers, headers, leads, valves, furnace brickwork, grates and all other items that are found in this part of the system.

The water tenders are in charge of the fireroom watches when the boiler-room engineers are off duty, are immediately responsible to the watch engineers, and have a quota of firemen under their charge, as well as all other men of the fireroom force. Among the principal duties of the water tenders are the watching of the boiler feed and regulating of the water supply so that with a heavy demand the station will not be caught with water too low, and then when absolutely obliged to put in water in larger quantities than usual, causing extra heavy firing and a reduction in the efficiency of the boiler plant, the observation of decreasing loads and adjustment of the water to correspond; the observation of the depth of the fires and anticipation of opportunities to bank, fire, light or clean; observation of steam leaks and reporting of necessary small repairs to the watch engineer.

The firemen are selected men of reliable temperament whose duties are to burn coal with care; who will use judgment in both firing and cleaning; observe the character of coal which comes through to the boiler-room and regulate the depth of stoker feed and the speed of the grate in accordance with the quality of fuel and the demand for steam with prompt action under instructions. The coal-passers look after the cleaning of the boiler-room in addition to the handling of the fuel.

The chief electrical operator and the chief engineer of the steam division each have a clerk to assist in miscellaneous and routine record work. The entire electrical and steam system is interconnected by a telephone service focused on a private branch exchange at L Street, which is equipped with lines to all substations and the general offices of the company. Three operators handle this service. The plant at L Street operates on three eight-hour shifts daily.

At the present time the engine station at L Street is used mainly as a stand-by plant and as long as it is economical to carry the load on the turbines and transform the energy necessary to supply the 2300-volt circuits of the company, the steam-engine installation is allowed to stand still. When for any reason it has been necessary to operate the engine station, these units are the first to be taken off the line as the load decreases. At present the temporary service supplied at 4600 volts is being taken through two banks of transformers, three units being of 500-kw rating and three of 900 kw. The two sections of the L Street station are tied together by three 1000-kw transformers wound for a conversion from 6900 volts to 2300 volts. The company is planning to increase its transmission potential on some of its outlying substation lines from 6900 volts to 13,800 volts during the summer in anticipation of future demands, and this work will be handled at L Street by two three-phase, air-cooled General Electric 5000-kw transformers.

The draft over the fires at L Street averages about ¼ in., a draft of ½ in. being secured at the peak load. The stacks in the turbine section give a draft of about 1½ in. The chimneys are equipped with automatic damper regulators, hand damper regulators being on the individual boilers. The hand dampers are set for the anticipated conditions of each watch at the beginning of the run. The chimney dampers are set in the turbine station to partly close at 178 lb. steam pressure. A carbon-dioxide recorder is in service in the boiler plant of the turbine station, the average percentage of CO_2 being about 13. The stokers in this division of the plant are operated by motors, provision being made for maintaining continuous service in case any single motor fails. The stoker adjustment for service is made by setting a nut for the throw desired. City water supplies the make-up for the boiler feed in the turbine plant. The ashes average from 9 per cent to 11 per cent by weight as taken from the pits. This work, with the weighing of the coal, is handled by the coal passers. The boiler tubes are blown off about every two days and the boilers daily. Coal is crushed to a size that could pass through a 2-in. ring in the fuel-handling and conveying installation. The turbines operate on from 28½-in. to 29-in. vacuum, with a 30-in. barometer. The daily coal consumption check is made on a 24-hour run beginning at 7 a. m. The lubrication of the turbine bearings is overseen by the steam division oiler on duty at each machine. Spare governor parts, valves and step blocks are kept in reserve for turbine use. The coal supply is protected by a hydrant system against fire. Engine, cylinder and dry-air pump oils are used in the plant. On each watch the condenser water going back to the boilers is tested for salt-water leakage by the usual nitrate of silver test. The station piping is not arranged according to any color scheme. No trouble is experienced from boiler scale, but compound is used as a precautionary measure. The turbine step bearings are water cooled. On account of the depth of the intake and discharge conduits no trouble has been experienced in the plant from ice. The temperature of the intake water varies on the average from about 30 deg. Fahr. in winter to 70 deg. in summer.

Hourly readings are taken and recorded in the steam division as follows: Time and state of individual boilers banked or steaming; feed-water temperature, and steam pressure. The times at which boilers are blown down and fires cleaned are recorded on the station log. In the turbine-room the steam pressure on each unit, the vacuum, feed-water temperature at each unit, and temperature of the condensed steam are taken and recorded hourly, together with circulating-water intake and discharge temperatures. The barometer is read three times a day. The time is also recorded for the turning over of each turbine unit started, the time of starting and the time when each machine was shut down.

Communication between the operating and turbine-room is effected by a Corey engine-telegraph installation giving the indications of ready, start, stop, turn, speed, trouble, stand-by, etc. Telephone connection is also available, and in addition the operator on duty in the electrical switchboard-room has a megaphone. Separate switchboards are provided for the station power and lighting circuits, and the latter are arranged so that in case of trouble on the alternating-machinery lines a transfer can at once be made to the exciter bus and battery, thus keeping lights in service in the more important parts of the turbine-, engine- and boiler-rooms. Each turbo unit is provided with a frequency indicator to assist the watch engineer in bringing the machine up to speed. All 2300-volt totality switchboard meters are given a regular monthly check by the standardizing and testing department. Meters on arc service are checked half-yearly. In addition many meters are checked on special order. Integrating meters are installed in the circuit of each generator, feeder and transmission line and the meters on generators are checked twice a month and quarterly on feeders.

The 40 arc generators and 20 synchronous motors in the engine station are operated by two men, who also look after three exciters. A third man per shift assists in the regulation of the voltage on the 2300-volt service of the company. The arc sets are inspected and cleaned thoroughly each day, air pressure at 75 lb. being used for blowing out such apparatus. One

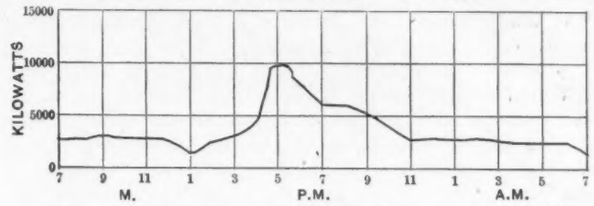


FIG. 10.—LOAD DIAGRAM, 4-1 ENGINE STATION, DEC. 22, 1908.

cleaner can look after 10 sets, and also perform minor duties. Each turbine in the 4-2 station is handled by an oiler under the supervision of the watch engineer. The turbine-unit electrical control is all handled from the electrical operating-room. In starting or stopping a turbine the watch engineer takes the throttle and co-operates with the electrical operator according to the signals received and sent. Ordinarily about eight minutes are allowed to bring a turbine up to speed ready for synchronizing, but in emergencies this can be done in less than a minute. Both the turbine and electrical rooms are equipped with synchroscopes. No regular attendance is required in the oil-switch-room, busroom or cable-room of the turbine station.

After a turbine has operated approximately 75 hours to 100 hours, the electrical parts are thoroughly inspected. Every four months the unit is taken apart and cleaned, blown out, inspected and varnished. With all possible care the accumulation of dirt in the narrow air-gap is frequently so considerable that many hours are required to remove it from the inner parts of the machine. The turbine brushes are inspected nightly, but Sundays are used for more general inspection in the station than any other days, on account of the lightness of the load. Installed in the armature laminations of each turbo-alternator is a recording thermometer of the Bristol type. The company endeavors to keep the armature temperature down to about 58 or 60 deg. C., a rise to 80 deg. being considered dangerous, with a room temperature of 25 deg. A power-factor indicator is connected with each unit in the electrical operating-room. Each turbine panel carries three alternating-current ammeters, one

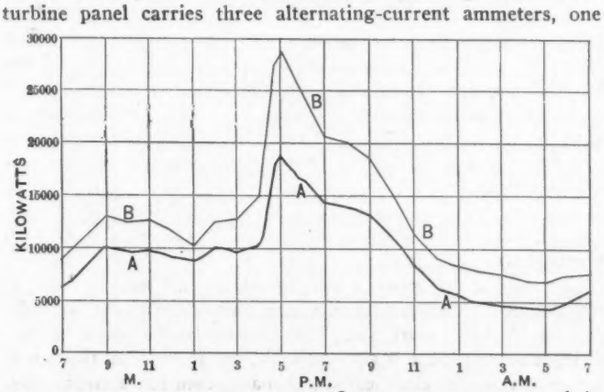


FIG. 11.—LOAD DIAGRAM, DEC. 22, 1908, 4-2 TURBINE STATION (A); TOTAL L STREET (B).

voltmeter, a field ammeter and kw-meter. The turbines are equipped with hydraulic governor valves, motor controlled. Arc sets are started through auto-transformers on half voltage, about 25 minutes being required to start up all 20 of the motor generators.

Each turbine is provided with a non-automatic reverse-current relay which shows a lamp signal at the switchboard panel in case of reversal of current. Automatic circuit-breakers are installed in the 2300-volt lines and set for three times normal full-load current. Time-limit relays are installed in the transmission and 4600-volt circuits. Arc circuits are tested three times daily for low voltage, and a galvanometer insulation test is made six times a week. Inter-station lines are tested for insulation semi-annually.

Daily station reports are sent to the generating department office showing the number of men on and off duty during the 24 hours, extra men employed and the reasons, time of starting and shutting down city arc lines, feeders out of circuit, dynamos not ready to run, repairs made, and unusual happenings. Recording wattmeter readings are sent to the office daily in two field books which alternate between the office and the station. Records are also made showing the readings of indicating wattmeters on all generators, feeder, auxiliary and transformer circuits by shifts, per hour, with the turbine loads and power factors. Systematic use is made of synchronous apparatus in order to keep up the power factor, which averages from 89 to 90 per cent. A daily record card is sent to the office signed by the chief engineer and the chief electrical operator, showing the coal consumption, engines running, water used, kw-hours generated and assigned to the different services, boilers and engines not ready for service.

The climax of the station year is the December peak, which is shown for 1908 in Fig. 10 for the engine station 4-1 at L Street; Fig. 11, the turbine station 4-2, and the two combined. The maximum load on the L Street plant was about 28,000 kw at 5 p. m., Dec. 23, 1908, the total load on the Atlantic Avenue station and batteries bringing the maximum output at this time to about 35,000 kw. The division of the load between the two sections of the L Street plant shows that the bulk of the energy was generated by the turbine station. There were nine engines and turbo-generators in operation at 5 p. m. The curve shows the time in which each machine was cut in and out of service in relation to the load. The minimum number of machines in service was three. The rating of each engine unit was 1500 kw. Turbines 3 and 4 are 5000-kw units and turbine 5 is an 8000-kw outfit. The normal rating of the generating units in service at 5 p. m. was 31,000 kw, figuring the largest turbine at its guaranteed continuous capacity of 12,000 kw. The number of boilers operated under steam in the maximum hour was nine, with one banked in station 4-1; in station 4-2, 12 boilers were steaming and none was banked at the time of the peak. The number of 24-hour men required to handle the station in December, 1908, was 91.

Practical Operation of Fisk Street and Quarry Street Stations in Chicago.

As is shown by the load curves accompanying this article, by far the greater part of the electrical energy generated by the Commonwealth Edison Company, of Chicago, is produced at the Fisk Street and Quarry Street power stations, both of which have been described at length in previous issues. An exhaustive account has also appeared in this journal relating to the operating practice of the company, applying more particularly to the outside transmission and distribution. But the actual operating conditions under which the stations are made to do their work day by day still remain to be described, and it is the purpose of the present article to give in outline an idea of this very important feature of the company's work.

The Fisk Street generating station is placed on the South Branch of the Chicago River, near the corner of West Twenty-second Street and Fisk Street. Just across the river is the newer Quarry Street plant. There are 10 9000-volt, three-phase, 25-cycle turbo-generators in the Fisk Street station, having a total maximum rating of about 120,000 kw. In the Quarry Street station there are three generating units of similar type, but rated at 14,000 kw each. Thus the rating of the two stations is about 162,000 kw. In addition, the company generates both direct current and 25-cycle alternating current at the old Harrison Street station and has still other generating stations in reserve, in addition to numerous storage batteries connected to the system. As will be noted by the curves, the peaks of the load are taken by the Fisk Street station, the newer and even

more economical Quarry Street plant being operated at practically steady load to attain its greatest efficiency.

Both the Fisk Street and the Quarry Street stations are operated under the supervision of one chief engineer, who reports to the chief operating engineer at the downtown office at 139 Adams Street. Each station has its own independent opera-

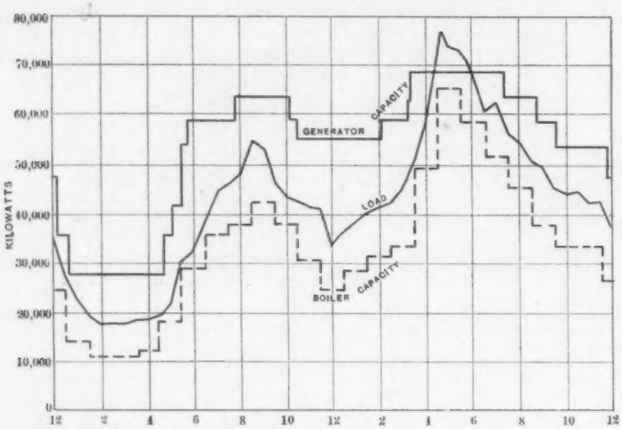


FIG. 1.—GENERATOR, BOILER AND LOAD CURVES.

tion staff, however, under the direction of assistant chief engineers for each station. There is a chief electrician and an assistant to chief engineer to assist in the operation of the two stations, the former being responsible for the electrical end and the latter for the steam end of the plant. Operating organization charts for the two stations are given herewith. The two plants are connected by a ferry on the river, and, of course, by telephone. They are also electrically connected by two tie lines, each cable being capable of transmitting at least 12,000 kw.

The stations form independent generating plants, so that a breakdown in one would not affect the other, yet are near enough together so that they enjoy the economy and convenience of combined operation. The assistant chief engineer for each station is held responsible for his own plant, reporting to the chief engineer, whose office is in the switchhouse at Fisk Street. The assistant chiefs have their offices in their respective plants. About 400 men are needed to operate the two stations,

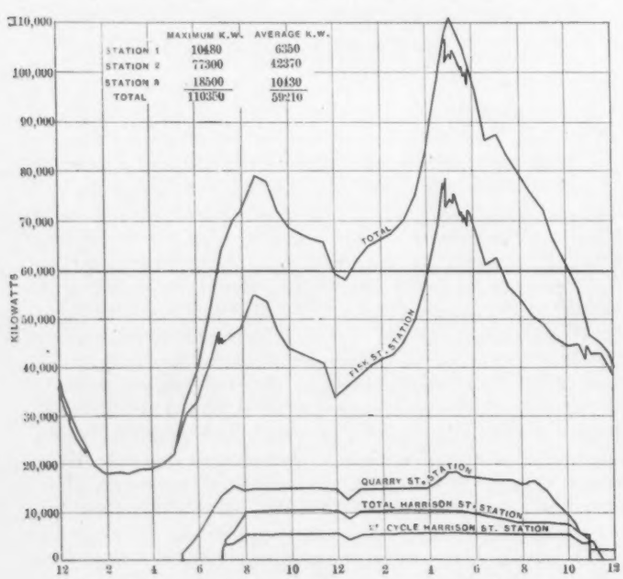


FIG. 2.—LOAD DIAGRAM. TOTAL OUTPUT DEC. 8, 1908.

and they are divided into three eight-hour shifts. Fisk Street is operated continuously, never having a load of less than 15,000 kw, but Quarry Street is shut down from midnight to 5 a. m. By far the greater force of men is employed at Fisk Street owing to its larger size, 24-hour operation and the fact that all repair work and auxiliary operation, such as welfare work, are centered at this plant. What follows descriptive of the operating practice of the two stations will therefore be considered to refer to Fisk Street unless Quarry Street is specifically mentioned.

OPERATING ROUTINE.

As stated before, there are three watches. Ordinarily these are from 7 a. m. to 3 p. m., from 3 p. m. to 11 p. m., and from 11 p. m. to 7 a. m. These are the hours of the watch engineers and of the majority of the men, but broken watches are also arranged for a portion of the men so that there are men on duty with overlapping hours and the arrangement is such that the greater part of the force is on duty at the hours of peak load.

During each watch there is on duty one watch engineer, and at Fisk Street a first and second assistant watch engineer. The watch engineer has a responsible position. He has charge of the operation of all steam-driven machinery, and is responsible for all machines available for carrying the load of the station. He keeps himself informed concerning the load condition and confers with the boiler-room engineer about the possible and probable operating and load conditions. He must know at all times the boiler capacity immediately ready for service. He keeps in touch with the switchboard operator and load dis-

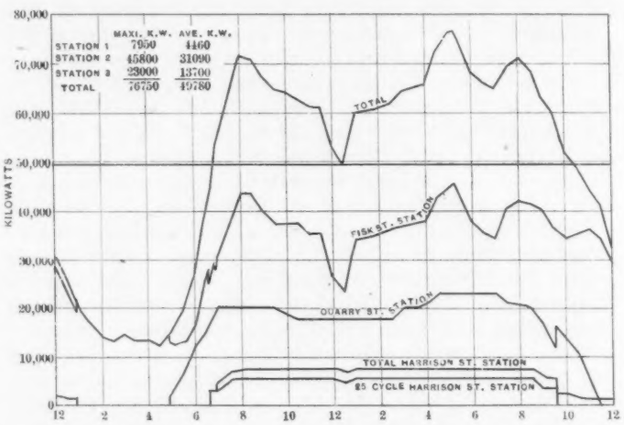


FIG. 3.—LOAD DIAGRAM. TOTAL OUTPUT APRIL 27, 1909.

patcher. The load dispatcher, by the way, has his office in the downtown headquarters of the company. With his assistants the load dispatcher directs the opening and closing of all switches throughout the entire system, including generating stations, substations and storage batteries.

In the absence of the chief engineer or his assistants the watch engineers at Fisk and Quarry streets have charge of the stations. A log is kept of the operation of the station, and on reporting for duty the watch engineer examines the entries of the two previous watches in the log to ascertain the exact condition of the apparatus given into his charge. He signs his name in the presence of the preceding watch engineer to signify his understanding of the conditions entered in the log, and thereupon relieves the preceding watch engineer. During his watch, in turn, he enters in the log all proceedings of operation or changes affecting the apparatus in his charge. In case of serious accident, the watch engineer must immediately notify the chief engineer, his assistant and the load dispatcher. The first assistant watch engineer gives all his time to assisting the watch engineer, but the second assistant does some operating and repair work, but is available for general supervision in emergency.

At this time of the year the morning load begins to pick up sharply before 5 a. m. and rises steadily to about 8 a. m., when the morning peak on the system is experienced. This is due to the fact that the company supplies so great a proportion of its output to railway companies. The fact that people all go downtown about the same time makes the morning demand heavy. In the winter the evening peak, coming on late in the after-

noon, is much heavier than the morning peak owing to the heavy lighting load.

There are two operating switchboard galleries at Fisk Street, and from these are displayed placards to show the load on each of the generating units in operation. These figures are changed by the switchboard operator from time to time, as necessary he inspects the governor, top and middle bearings, valve mechanism and all oil lines to and from the turbine. He keeps a close watch on the temperature of all return oil from bearings at step, and he at once investigates any abnormal rise in temperature or any interruption of flow, at the same time reporting the fact to the watch engineer. His assistant helps him

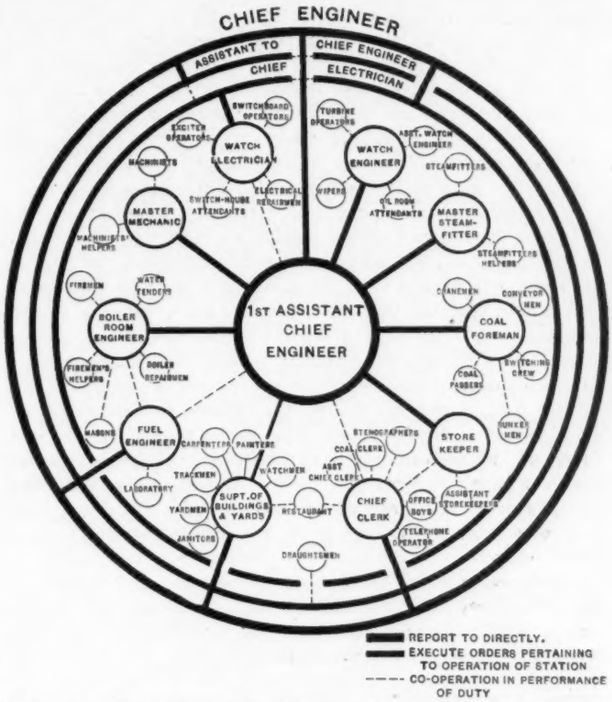


FIG. 4.—OPERATING ORGANIZATION CHART FOR FISK STREET STATION.

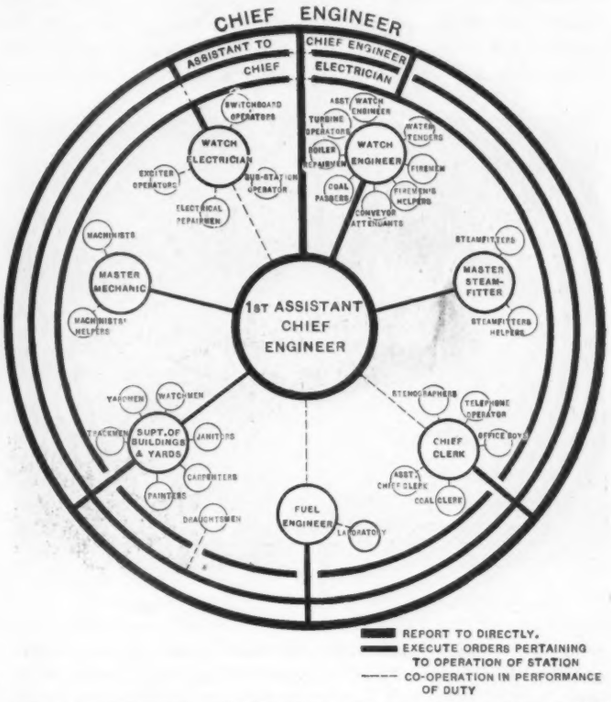


FIG. 5.—OPERATING ORGANIZATION CHART FOR QUARRY STREET STATION.

the load varies on the units, and the watch engineer and his assistants watch them closely. As the figures increase toward the maximum rating of the machine, the watch engineer causes other boilers and generators to be started up before the maximum capacity of the machines already in use is reached. In addition, the watch engineer keeps a careful outlook on the weather. If he sees a storm coming up which will mean darkness and a consequent sudden rush for light, he must be prepared for this demand with both steam and electrical units, first notifying the load dispatcher. Within 15 minutes the watch engineer without special preparation can have one unit, consisting of the turbo-generator and the eight boilers that go with it (in the case of Fisk Street), ready for service.

The switchboard operator also watches the load very carefully, and if it comes up rapidly he notifies the watch engineer. The busbars in Fisk Street are sectionalized, and not more than 50,000 kw is permitted on one set of buses. As a rule, the watch engineer or one of his assistants stands by while each new unit is being started. A signal system between the operating switchboard galleries and the floor of the station is provided. When a machine is ready to be thrown in, the turbine operator blows a whistle, which notifies the switchboard operator that the machine is ready to be synchronized and put on the system. As soon as the switchboard operator hears this signal he synchronizes the machine and closes the main switch connecting it to the busbars, giving a signal to the watch engineer that the machine is on the system. At the same time he notifies the load dispatcher. Similarly, when machines are cut out, a corresponding routine is observed.

One turbine operator is provided for each unit for each shift. He is responsible for the efficient operation of the turbo-generator and its auxiliaries to which he is assigned. He looks out for the lubrication and sees that the highest possible vacuum is maintained in the condenser. He watches to see that the various gages indicate normal conditions, and as often as generally in the performance of these duties and specifically is charged with the duty of keeping the unit in a neat and clean condition.

Neither the turbine operator nor the assistant is permitted to leave his unit except to call for assistance without the permission of the watch engineer or his assistant. In case of accident the turbine operator must station himself at the throttle and the assistant on the floor between the Corliss and feed pumps ready to execute orders from the watch engineer or his assistant. Twenty-one turbine operators are required for the Fisk Street

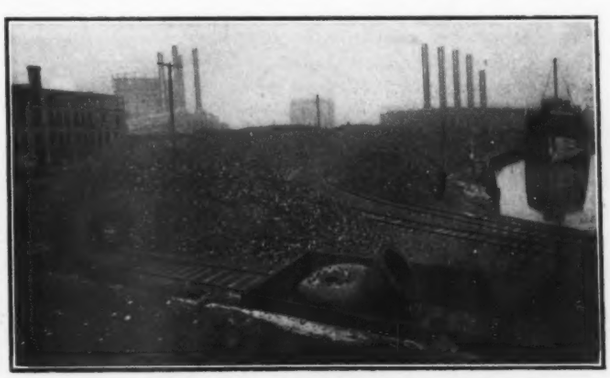


FIG. 6.—COAL STORAGE FOR FISK AND QUARRY STREET STATIONS.

station, the arrangement of watches being such, of course, that the greatest number is on duty at times of peak load.

When all the units in Fisk Street station are in operation 250 gal. of oil a minute, or 15,000 gal. an hour, are needed for the film of the step bearings on which the revolving parts of these great machines turn and also for lubrication. There are three oil rooms for oil wells, pumps, filters and the like, and

each of these has an oil-room attendant during the busy hours. At night one oil-room attendant looks after the three rooms. At Quarry Street the oiling arrangement is quite different. Here the oiling system is a part of the generating units, and the turbine operator looks after it.

BOILER-ROOM PRACTICE.

All steam-generating apparatus, including steam piping in the boiler-room, coal- and ash-handling machinery and also the shifting steam locomotive in the yards, is in charge of the boiler-room engineer. This man reports direct to the assistant

FIG. 7.—ONE OF THE BOILER-ROOM BAYS, FISK STREET STATION.

chief engineer for his station, and he is held responsible for the maintenance, operation and the efficiency of the men in the boiler-room. He sees that the boilers are kept in first-class condition, and he hires and discharges the men in the boiler-room. The watch engineer directs which boilers shall be put into service and which shall be kept in reserve with fires banked in anticipation of coming load. In general, the watch engineer directs the use of the boilers, but the boiler-room engineer must see that plenty of boilers are ready for service at all times. He has at Fisk Street 80 boilers in his charge. His hours are from 8 a. m. to 5 p. m. He notifies the watch engineer in writing of the probable time when boilers down for repairs will be available for service. He keeps a daily record on the "boiler-room report" of all the work in progress or completed. He also keeps a daily "fuel report," showing all coal consumed daily for each unit and the amount of coal in storage each morning. He also directs the work of the masons engaged in making furnace repairs.

For each 16 boilers one water tender is provided. The firemen and firemen's helpers report to the water tender. The water tender sees that the boilers are properly fired and reports to the boiler-room engineer. It is to the water tender that the watch engineer gives orders when to put boilers into service and when to cut them out. The water tender maintains normal water level in his boilers and must see that they are fired in such a manner as to produce the most economical results. He must see that the safety valves are tested once a week and is responsible to the boiler-room engineer for the efficient operation of the steam-generating apparatus to which he is assigned. He must be prepared to take care of any emergency or sudden change of load. When the boiler-room engineer is not on duty he reports direct to the watch engineer.

OPERATION OF ELECTRICAL APPARATUS.

As before stated, there is a chief electrician, who reports directly to the chief engineer, supervising the electrical operation of both stations. Reporting to him is a watch electrician for each watch, who is responsible for handling all electrical apparatus in the generating-room and switch house. He does all dangerous work in making electrical connections or any testing; in fact, he is responsible for the operation and maintenance of the entire electrical equipment of his station. He makes daily inspections of the electrical equipment, including ground tests on all of the exciters and exciter buses. He also makes insulation tests on the fields of all generators not in service and such other tests on lines and apparatus as may be assigned to him by the chief electrician or the load dispatcher.

In the absence of the chief electrician, the watch electrician on duty assumes full charge of the electrical department. Like the watch engineer, he carefully examines the entries of the two previous watches in the switchboard and exciter system logs on reporting for duty. Similarly, he enters all proceedings of operation in the proper logs during his watch. It is a part of his duty to instruct his subordinates in the safest and most efficient methods of performing their various duties. He notifies the chief electrician in case of trouble and in case of serious accident the chief engineer and the load dispatcher also.

A switchboard operator and an assistant are on duty at each operating switchboard gallery during each watch. The switchboard operators rank next to the watch electrician, and do all the switchboard operating. They open and close all switches on the switchboard and put the generators on or off the system, working directly under the supervision of the load dispatcher at headquarters and in conjunction with the watch engineer. In case of any trouble the matter is reported to the watch electrician, who straightens things out. Should an emergency require prompt action, however, the operator may use his own judgment and act without orders except in closing line switches, replacing clips and separating the busbar system, but when time will permit such operations are performed upon order only, after due notice to the load dispatcher, watch engineer and the exciter operator.

It is the duty of the switchboard operator to keep informed of general operating conditions, and he advises his superiors of any unusual conditions. In case of serious trouble the switchboard operator devotes his attention to the operation of his station,

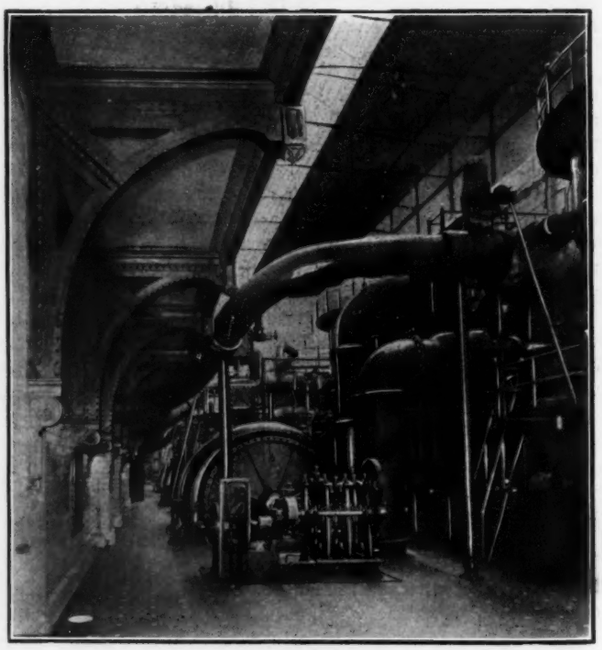


FIG. 8.—VIEW ON FLOOR OF TURBINE-ROOM, FISK STREET STATION.

while his assistant keeps the load dispatcher posted on the nature of the trouble and general operating conditions. The chief electrician and the watch electricians are the only men in the station authorized to place and remove high-potential transformer fuses, close and open disconnective switches and place and remove ground connectors, but in emergency the switchboard operator may send a man to perform these duties, but the man so sent shall call the load dispatcher and receive his order direct before performing any operation of this kind. The switchboard operator keeps a log of all operations.

Exciter operators are responsible for that part of the exciter system to which they are assigned. They also look after the supply of electricity for the motors, signal lights connected to the auxiliary bus, electrically operated valves on the turbines, and relay and operating supply for the switchboards and operating galleries. The exciter operator keeps sufficient exciters in service to maintain normal field excitation without overloading the exciters or discharging the batteries. He also charges the excitation batteries according to instructions from the chief electrician, and it is his duty to keep in touch with the switchboard operator and the watch engineer regarding changes in load distribution. He keeps a log and also, on forms provided, a record of the excitation.

At Fisk Street the oil switches and the principal switching apparatus are in a separate switch house. The rooms in this switch house are in charge of switch-house attendants, who operate the recording integrating wattmeters according to instructions and also keep a record of the loads on the various generators, exciters and lines. These men keep a close watch on all signal lamps to insure a supply of electricity to the relays in the oil-switch control circuits. They immediately notify the load dispatcher of any overloaded line. In case of any irregularity in the operation of the oil switches, the switch-house attendant notifies the load dispatcher and the watch electrician. He examines the locks on generator switches, tie switches and line switches to see that they are properly set before attempting to operate the switches. In his log he keeps a record of the time of the opening and closing of all switches and of other proceedings in the switchroom to which he is assigned. He also enters all work in progress on electrical equipment in the

FIG. 9.—VIEW IN TURBINE-ROOM, FISK STREET STATION.

switch house, all checking of meters, all electrical tests made from the switch house and a record of all apparatus out of service.

FUEL INSPECTION, REPAIRS AND OTHER FEATURES OF OPERATION.

An important functionary in the operation of the two stations is the fuel engineer. He makes tests of boilers and tests of different kinds of coal, determining the relative heat values of the latter. He advises the chief engineer as to what coals give the best results and whether the furnaces and boilers are in good condition. He makes a scientific analysis of the fuel and points out how to get the best results from it. As 75 per cent of the operating expenses in these stations is due to the money spent for coal, it is very important to keep a close watch on the fuel end. The fuel engineer also makes tests of ashes taken away to see that there is no waste by unburned coal, showing whether the furnaces are in good shape and whether the firemen are doing their duty. He has the supervision of laboratory assistants for fuel analysis, and the coal buyer at the downtown office is guided by his reports and tests.

The coal foreman reports to the assistant chief engineer at

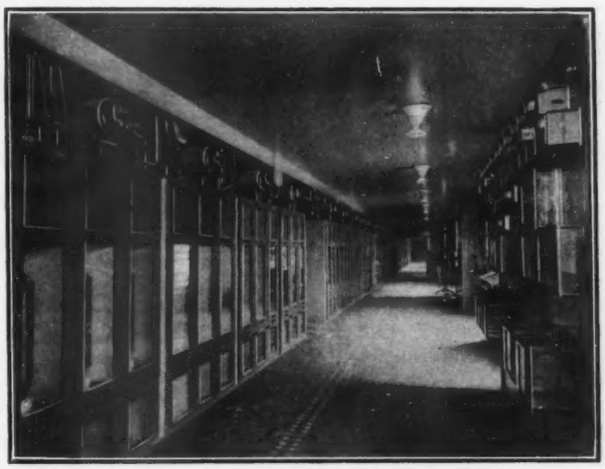


FIG. 10.—SWITCH HOUSE, FISK STREET STATION.

Fisk Street. He has charge of the handling of coal in the yards and sees that plenty of coal is kept in the bunkers and that all refuse is removed from the station. The coal passers, conveyor men, yard masters, switching locomotive crew, etc., report to him.

Renewals and repairs to machinery are made in a repair shop, which is in charge of a master mechanic. When anything is broken the trouble is reported to the master mechanic, and he takes charge of all overhauling, the watch engineer turning the matter over to him. The machine shop is in the Fisk Street building, and here the master mechanic, with a force of machinists and assistants, does the repair work for both stations.

The master steam fitter has a pipe shop and a force of pipe fitters. He takes care of all piping in both stations, and has a force of steam fitters and laborers to assist him.

There is a superintendent of buildings and grounds, and under him are the painters, carpenters, janitors, tinsmiths, track foreman and track crew. The last named have to do with the railroad tracks in the yards, of which there are five or six miles, one steam locomotive being used for switching. The building superintendent keeps up the buildings, grounds and tracks and sees that everything is kept neat and tidy.

All supplies, both steam and electrical, are kept in a storeroom, which is in charge of a storekeeper. When supplies are needed application is made to the storekeeper and the person applying must have written requisitions signed by persons authorized to do so, such as the watch engineer, boiler-room engineer, master mechanic and others.

In such a large organization there is a considerable force of office help needed. A branch telephone exchange is maintained in the office, which is located in the switch house, and there is a chief clerk, who has charge of the entire office force. The fuel clerk makes daily reports to the chief clerk of all fuel burned and of number of cars of coal coming in and cars of rubbish shipped out.

One feature of the welfare work of the Commonwealth Edison Company is a large restaurant for employees which is maintained in the switch house at Fisk Street for the benefit of the staffs at the two stations. Meals are furnished at all hours at a fixed price which averages about two-thirds of the actual

cost, the company defraying the remainder. Ordinarily the restaurant is open from 6:30 to 8 p. m., but in case of any unusual happening it is kept open at night. A competent woman is in charge and she reports to the superintendent of buildings. At this restaurant as many as 185 of the Edison people have been fed at one time.

Watchmen are on duty to guard the main entrances to the property, and they admit only such persons as have proper authority to enter, it being necessary for visitors to obtain passes from the downtown office. The watchman sees that all employees register on their cards on entering and leaving and also records the number and time of all cars entering and leaving the yard. During the daytime two watchmen are on duty, one guarding the entrance, while the other patrols the property, keeping a careful lookout for fire or any other unusual occurrence. The patrolman records his progress by means of watch boxes provided for that purpose. He notifies the watch engineer in case of trouble, and in case of fire turns in an alarm.

FIRE PROTECTION.

Both stations have elaborate systems of fire protection. The watch engineer on duty is also the fire marshal, and certain men who can best be spared from their ordinary duties are assigned for fire-service duty, organized into three companies, each with its own captain. Some of these men are pump men, some pipe men, some nozzle men, etc. An ample supply of fire-fighting apparatus is kept on hand, and it is the duty of the superintendent of buildings to inspect this paraphernalia from time to time.

The property on each side of the river is divided into fire districts, there being six of these districts at Fisk Street and six at Quarry Street. Within these districts are placed 38 fire-alarm boxes. When a box is "pulled" a fire whistle on the station indicates the number of the district by the number of blasts. On hearing the alarm the captain of each company runs to the fire-pump room where he notes the location of the box on the fire-alarm register. While the captain is ascertaining the location of the fire, his men are getting out the apparatus, and by the time he is back with the information to the fire station the company is ready to proceed to fight the fire. There are 15 fire-alarm boxes on the Quarry Street property and 23 on the Fisk Street side.

Operating Features of the New York Edison System.

THE system of the New York Edison Company comprises two main generating stations known as Waterside No. 1 and Waterside No. 2, and 23 substations; together with extensive underground distribution circuits. One substation has 8000 kw in steam-driven generating machinery for emergency use; another has 900 kw of generating machinery, while a third is equipped with 1700 kw of steam-driven apparatus which is held in reserve for winter peak conditions. All of the substations are equipped with storage batteries and by fall there will be storage batteries available on the system having an output of approximately 100,000 amp at a three-hour rate of discharge.

The huge stations on First Avenue, Thirty-eighth, Thirty-ninth, Fortieth Streets and the East River have already been described in detail in our columns; the newer station, Waterside No. 2, having been described at some length in our issues of March 4, 11 and 25 and April 8 this year. Many of the operating features connected with the system were incorporated in these articles and had space permitted much more could have been written. The system has never been completely shut down since since it was established and regularly operated as a commercial proposition, or in a period of over 25 years, and such an exceptional record could not have been secured without good organization and without in some measure anticipating what might happen and then guarding against it.

There are between 700 and 800 men employed in the operation of both Waterside stations. These are located on adjacent blocks and in practice are operated as a single station; there being heavy ties between the high-tension buses and interconnected steam and water mains, so that from a mechanical as well as an electrical viewpoint the stations may be considered as one. Moreover, the underground network is very solidly connected, adding greatly to the rigidity of the system. The substations feed into the network at such points as will give them their share of the load, and by having three bus voltages and by transferring the feeders from one to the other as charging conditions of load require, a uniform pressure is maintained on the system. On the first of the year there were connected to the system 3,480,719 incandescent lamps, 32,516 arc lamps, 1106 vapor arc lamps, 1103 kw in heating apparatus, 4430 kw in storage batteries and 205,373 hp in electric motors. The maximum load carried by the station on Dec. 22, 1908, was 135,000 kw.

The operating force is under the direct supervision of the electrical superintendent of the station and his assistant, who report to the associate general manager and the chief engineer at the company's main office on Duane Street. The distribution of all energy from the station is controlled by the system operator, whose station is on the switchboard gallery in Waterside No. 1. The general operating force works in three shifts. Ordinarily these are from 11 p. m. to 7 a. m., from 7 a. m. to 3 p. m. and from 3 p. m. to 11 p. m. There are two other shifts from 1 a. m. to 9 a. m. and from 2 p. m. to 10 p. m. which cover peak load periods.

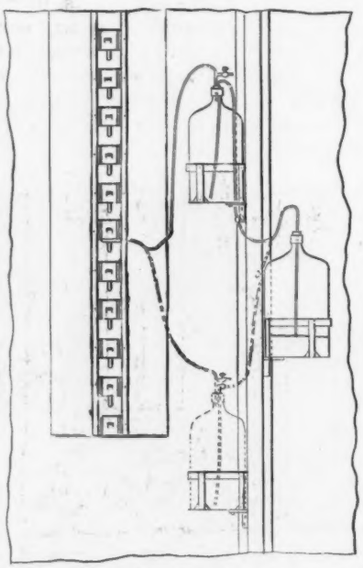


FIG. 1.—CONTINUOUS GAS-SAMPLING APPARATUS.

The boiler-room engineer is responsible to the chief engineer of the system, who instructs him as to repairs and directs which boilers shall be kept in reserve, which put out of service, and who also sees to general operating conditions. The system operator by means of an illuminated sign signals the boiler-room engineer how many boilers are required under steam, and this signal must be acknowledged immediately by the engineer. One chief and three assistants are allotted to a watch in each station, under whom are four water-tenders and the necessary firemen. In Waterside No. 2 the boilers fitted with stokers are kept under load at all times, together with the necessary number of hand-fired boilers. The firemen have nothing to do but fire and the fires are changed every five hours. The boilers are fitted with shaking grates and the live coal is pulled forward while the rest is dumped into the ash pits. The cleaning periods are timed to come just before peak loads.

Each boiler is equipped with a continuous gas sampling apparatus and from this is taken an average sample every six hours which is analyzed by Orsat apparatus. Records are posted in the firerooms and from these a check is obtained on each fireman. For this purpose gases are sampled in the middle of the first pass of the boilers. Check samples are also taken period-

ically from the flues so as to obtain a record on boiler settings, leakages, etc. The double bottle arrangement used in sampling the gas is shown in Fig. 1. The bottles hold 5 gal. of water each, and one bottle siphons water out of the other. The firemen are changed about from time to time, so that one man does not always work near the window and another in a hotter part of the room near the partition wall.

All the fuel used is subject to test. The company has a well-equipped laboratory under the direction of competent chemists, who analyze every boat load of coal, making proximate analyses for daily records and ultimate analyses for records of special coal supply; using for daily records the calculated heat value of the fuel, with periodic calorimeter tests from average samples. All coal analyzed is taken from a continuous sample of each car load. These samples are taken with automatic apparatus from the coal delivered to the weighing hoppers. Ash analyses are made daily to determine the percentage of combustible matter in the boiler refuse as a further check on the firemen.

The fuel used is not purchased on specifications as usually understood. There are no bonuses or penalties; although the company reserves the right to reject coal that is not satisfactory. The anthracite coal is not bought in the open market, but is purchased direct from the producers so that the company can limit its purchases to certain specified mines. All the anthracite used comes from the Scranton district, while the bituminous coal comes from Pennsylvania and Maryland. The latter fuel must not contain over 20 per cent of volatile matter, 8 per cent of ash and 1½ per cent of sulphur.

Other features of boiler-room operation have already received consideration in our columns. It might be of interest, however, to state that during the summer months 30 banked boilers are kept connected to the line ready for instant use. By simply turning on the blowers these can be got under way in five minutes. Owing to the summer thunderstorms which come on suddenly, it has been found necessary to keep this number of boilers under steam during the day. At night the boilers are used to carry the peak load. As indicative of the summer day load conditions and of the rapidity with which these demands are satisfied, it might be stated that not long ago during a sudden storm the load increased in 10 minutes from 45,000 kw to over 85,000 kw, or over 90 per cent. This was taken care of in the main station without recourse to the batteries.

In the generator-rooms there is an assistant chief engineer for each watch, under whom are watch engineers and oilers for the auxiliaries of each turbine. Ordinarily there are two watch engineers on duty with the exception that after midnight only one watch engineer is on duty. The oilers look after a number of turbines and for the auxiliaries. As pointed out in previous articles, once the turbine throttle has been opened wide, the operation of the unit is controlled by the switchboard operator.

There are two electrical foremen in each station having under them a number of assistants who look after the switchboard and electrical galleries. During peak loads the electrical foreman designates some assistant to make a tour of the electrical galleries every half-hour, so that any fault developing at such critical times may be detected. During other portions of the day the galleries are inspected every two hours.

As stated previously and in other articles, the distribution of all energy from both stations and from substations is under the direct supervision of the system operator, who is responsible for the operation of the entire system. Feeders, rotaries, boilers, etc., are put in and out of service only on his order and he receives at frequent intervals reports from all substations giving the load on each feeder and the reserve held in the batteries.

In front of the system operator is a map with all stations, feeders, etc., painted in. Hooks are fixed at the feeder ends on which the operator places a blue tag if the feeder is dead, or a red tag giving the load on the feeder if it is in use. When a feeder is tied through one station to reach another, it is indicated on the operator's board by a piece of elastic ribbon with rings on the ends which are placed over the feeder hooks, thus completing the connection through the station. If a feeder is held off for any reason this is also indicated by a tag. One of the system operator's duties is to keep posted on the weather conditions, and besides receiving the weather bureau's reports he makes stated readings of the thermometer and barometer, notes the direction of winds, and the condition of the sky. During cloudy weather or when the clouds lower, the system operator notes conditions every few minutes. If a storm sweeps over the lower portion of the city which is not noticeable at the Waterside stations, even while it is yet a great way off, the system operator is apprised of its coming by either substation operators or others connected with the system, and has units ready to throw in.

The load is divided among the units so that, should the largest unit operating break down, the others can carry its load without becoming unduly overloaded. Moreover, another unit is always ready to be thrown into circuit, all the auxiliaries being in operation, so that by simply opening the throttle the unit can be got under way. A 14,000-kw set can be synchronized and thrown in in less than two minutes, and the reciprocating units

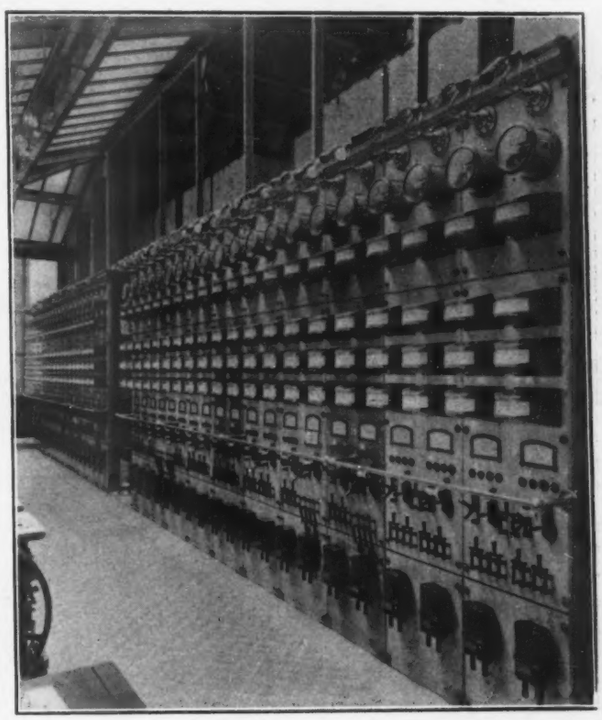


FIG. 2.—MAIN SWITCHBOARD IN WATERSIDE STATION NO. 1.

in Waterside No. 1 have been thrown in in about one minute time and again. If more than one unit is required, the system operator can order as many as are required started at the same time.

In emergencies, one blast of the 4-in. emergency whistle is sufficient to bring every operator to his post in less than a minute, and by means of the code signals sent over a system of gongs the operators in every substation connected to the system can be summoned to their switchboards and rotaries immediately. Thus every man connected with the actual operation of the system may be summoned to his post in less than two minutes and being under the supervision of one man, the system operator, whose orders are obeyed instantly, it will be appreciated that any untoward condition which is within the possibility of human agency to remedy will be corrected speedily. Should every source of communication fail, an improbable condition, and the operators in the various substations be thus deprived of a directing head, the company has instructed them how to act under such circumstances. How jealously the company has guarded its reputation for continuous service and with what

forethought it has anticipated trouble and provided for meeting it, will be evident from what follows.

HANDLING 6600-VOLT APPARATUS.

According to the rules of the company, all persons are prohibited from entering the high-tension galleries without permission, and no employee may handle or touch, either with or without rubber gloves, any switch, cable, bus, connection, conductor or any other apparatus which ordinarily carries 6600-volt current until he has positively ascertained that such apparatus is disconnected from all source of energy. If work is to be done on any part of the high-tension system in regular service, notice is given to the system operator as to the character of the work, and the approximate time required for its completion. If any alterations are to be made in the connection or location of any of the high-tension apparatus, or any addition is to be made, full information with a sketch is furnished to the system operator by the department desiring to make the changes or additions at least 24 hours before the work has begun. The foremen and operators in charge of stations are expected not to allow work to be started on the high-tension system or auxiliary apparatus connected therewith without first notifying the system operator.

Before beginning work on the apparatus, the foreman of the

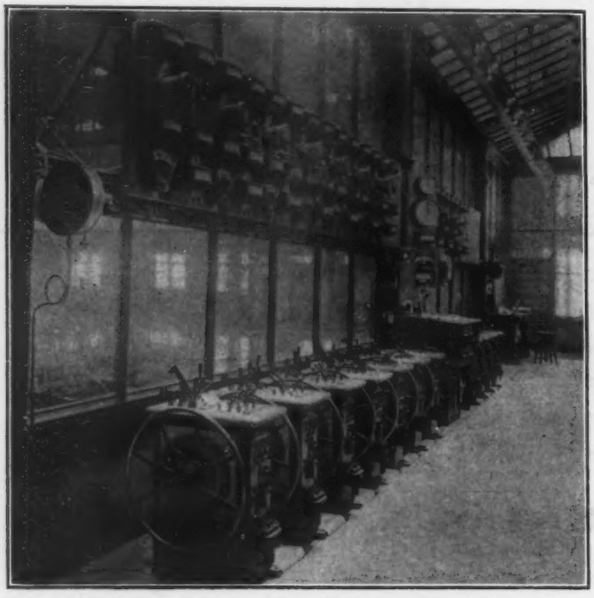


FIG. 3.—OPERATING GALLERY IN WATERSIDE STATION NO. 1.

electrical construction department ascertains from the operator in charge of the switchboard at the station in which the work is to be done whether the cable, switch, bus or other connection on which he desires to work is dead—that is, that it is not connected, either directly or through primaries of shunt transformers, with any source of high potential in any station, and that the cable, etc., has been discharged to ground since last carrying high-potential current. Before permitting the foreman of the electrical construction department to begin work, the operator in charge of the station notifies the system operator that the construction department is ready to proceed with the work, notice of which has previously been given. Upon word from the system operator authorizing the work, the station operator blocks the switches, attaches ground wires and places a "not clear" card on the apparatus. In applying the ground wires the operator first discharges the three conductors with a wire provided for that purpose, and then connects the three conductors together and to ground by means of a special device. In doing this work the operator is required by the company to wear rubber gloves and exercise great care.

The foreman of the electrical construction department personally inspects the blocking of the switches, the posting of the "not clear" cards and the grounding of the apparatus upon which he is to work. When he reports the work finished the operator notes the same in the high-tension log-book, and after a personal inspection notifies the system operator that the apparatus held off is again ready to be placed in service, and on instructions from him removes the switch blocks, ground wires and "not clear" cards. A note is made in the log book of this fact.

If it is desired to make an insulation test, or to do work on the high-tension cables in the subway, the system operator instructs the substation operator as to the blocking and grounding of switches, and the posting of "not clear" cards, and all such work is recorded in the high-tension log-book. If the cable is to be tested from the substation end, the person making the test personally inspects the discharging of the cable. In blocking type-H oil switches, the knife switch on the motor is opened and "not clear" cards hung on both the oil switch and the pilot switch controlling it. In blocking type-K switches, "not clear" cards are hung on the switch handles and on the pilot switch controlling the oil switch. In blocking the circuit-breakers, a cap provided for the purpose is placed on the under side of the air dash-pot, and a "not clear" card is hung in a conspicuous place on the panel. In blocking direct-current rotary converter switches, a combined blocking device and "not clear" card is placed on each of the outside pole armature switches on the direct-current switchboard. As a further precaution the direct-current circuit-breakers are left open. When work is being done on cables special care is used in blocking all switches, posting "not clear" cards and in returning to service those cables connected to substation switches which cannot be grounded. The operator immediately reports to the system operator any fault which develops in any part of the transmission or transforming system, or any incident which in any way affects the service or necessitates taking any of the transmitting or transforming apparatus out of service for testing or repairs.

HANDLING DIRECT-CURRENT FEEDERS BETWEEN GENERATING STATION AND SUBSTATIONS.

When the underground department desires to work on high-tension feeders, a representative is required to make a written request a day prior to beginning work, on a prescribed form, for such feeders as the department desires, stating fully the work intended to be done, the maximum time necessary for its completion and giving a rough sketch showing changes in connections or numbers. If necessary, the system operator sends a copy of this request to the electrical construction foreman at the Waterside station, and if the latter is ready with switches and apparatus to co-operate with the underground department, and to make a phase test if required, a note to that effect is made on the original request held by the system operator. The latter then shows the original request to the foreman operator on watch for his information, and he is required to sign the original request. The feeder or feeders are then turned over to the underground department, after being properly protected by the operating department in the generating station and substation on order from the system operator.

As soon as the work is completed the underground department is required to notify the system operator, and if no other department is working on the feeder or apparatus connected to it the system operator issues instructions to the operating department to remove all grounds, and to the electrical construction department or operating department to make a continuity test, and to the underground department to make a galvanometer test, unless he finds that such test would seriously interfere with the operation of the system, in which case it is omitted if it is deemed safe to do so. If the test is satisfactory the underground foreman presenting the original request reports in person to the system operator, notes on the original request the time of completion and signs his name, to which the system operator attests.

A feeder is tested for insulation with high potential, preferably from the generating station, or by the operating department with an inverted rotary converter in substation; the rotary being started from rest with both low-tension and high-tension alternating-current switches closed on the feeder to be tested. If a phase test is necessary after the insulation test is complete, the

electrical construction department at Waterside station is notified, and when the test is complete the foreman makes a note to that effect on the original request. If it is necessary to make a phase test in the substation, the electrical construction foreman does so. When the feeder is again ready for service the system operator has the original request signed by the foreman operator or operator on watch. This signature is taken as an evidence that the high-potential test was satisfactory, that the correct number cards have been placed on the switches and panels, and that all relays, etc., in the Waterside station have been properly adjusted. The system operator also ascertains from the substation operator, whose initials he places on the original request, that correct feeder numbers have been placed on all switches and panels, and that relays, etc., are properly adjusted in the substation.

The underground department is held responsible for giving the correct numbers and designations of feeders to the electrical construction department in both Waterside and substations. The underground department solders brass bands having proper numbers stamped on them to the lead sheaths of all high-tension feeders inside of the building line at Waterside station. If it is desirable to hold off a feeder for testing it is not necessary for the underground department to make a written request, since the matter may be arranged by telephone. The electrical construction foreman is required to notify the foreman operator and the system operator with regard to any changes in the position of feeder switches in Waterside station, and the number of same is given by the underground department, and also to notify the foreman or operator of the substation of any change of connections in the substation. If the electrical construction department wishes to disconnect feeders from the switch panel, or transfer to other switches, or do work of a similar nature, a similar practice is followed as outlined for the underground department.

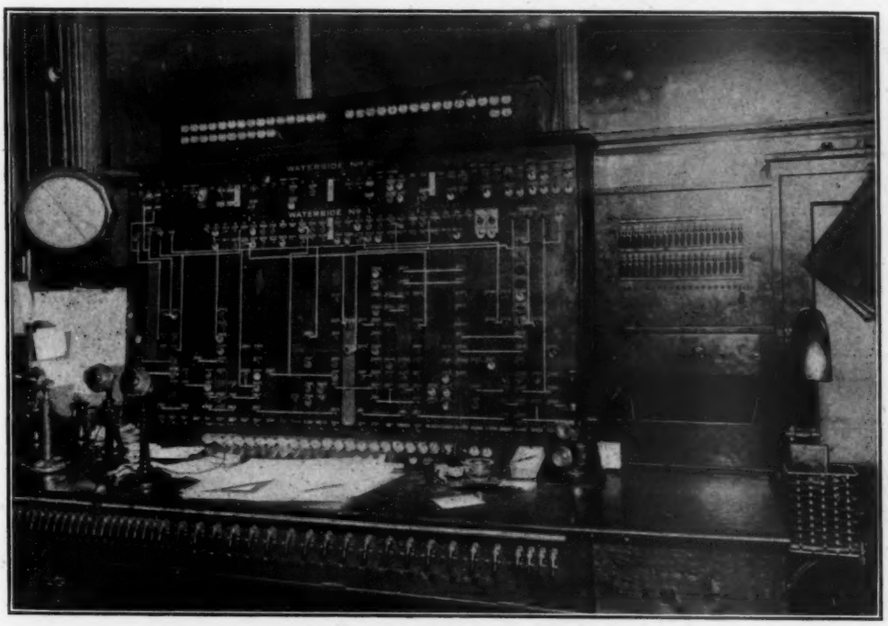


FIG. 4.—SYSTEM OPERATOR'S DESK IN WATERSIDE STATION NO. 1.

The system operator is very particular to require insulation and phase tests in all cases where there is the slightest possibility that underground clamps have been left on, or that the conductors have been twisted from their original position. The insulation test is preferably made at the Waterside station. As soon as the changes have been made the system operator corrects his operating map. In case of any trouble on the cable or subway system, the system operator immediately notifies the underground department, and takes all possible precautions to prevent further development of the trouble. In making tests, repairs, etc., on tie feeders between substations the regulations are somewhat similar to those already indicated for feeders between the generating and substations.

RESTORING SERVICE AFTER TOTAL INTERRUPTION.

If the service had been interrupted, and the accident is of such a nature that it can be promptly restored, specific instructions are issued to the various employees to guide them in this work. If it is unnecessary to clear the bus, and if the Waterside stations have been separated, they are left separated until normal conditions are restored, or until it is desirable to tie them together. If they have not been separated they are left tied. The feeders and as many generators as possible are left connected to the bus, and the voltage or frequency or both are reduced when necessary, so that the substations can readily reconnect the rotaries. The voltage and frequency are then raised as the load requirements demand.

If it is necessary to clear the bus, the generating stations are separated, if they are not already operating independently, until normal conditions are restored, or until it is desirable to tie them together. One generator is then connected to the bus, and several other generators are then synchronized and connected, the turbo-generators being used first, and then the reciprocating-engine units, the voltage and frequency being reduced if necessary. After the necessary feeders have been connected such other generators as may be required under load conditions are synchronized and cut in. In any emergency all of the substations are under general instructions to immediately take load from any feeder which is alive.

If it is necessary to start the rotary converters from the alternating-current side, the substations are notified to get ready to start from standstill. The engineer is notified to shut down all turbines, and to station a man at the throttle of each turbine, and to cause all available engines to be turned over slowly. The buses are cleared, and, if necessary, one engine-driven generator and one motor-generator are connected to a section of the bus, in order to supply the station lighting. The exciters are connected to this bus if necessary. The available bus in Waterside No. 1 is connected to the available bus in Waterside No. 2 by means of the station tie cable. All of the turbines which are shut down and are available for service are connected to the bus in each station, each with its field circuit closed and the rheostat half cut in. If any turbines are still revolving and it is desirable to quickly stop these so as to use them in starting up the system, one or two reciprocating engines are synchronized with them, the turbine throttles are closed, and then the engine throttles.

All of the feeders which were in service at the time of the accident are connected to the bus in each station, and if any of these are not available the substations are notified to keep such feeders clear, and if necessary the numbers of other feeders to be used in their stead are designated. When both generating and substations are ready one long blast of the emergency whistle is given, when the man at each turbine throttle opens the throttle just enough to open entirely the by-pass. At each succeeding blast of the emergency whistle the throttle of each turbine is opened one-sixth of a turn of the throttle wheel. As many single blasts of the emergency whistle as may be necessary fully to load the turbine are sounded, the intervals between blasts being sufficiently long to permit the turbines to respond to one setting of the throttle before another setting is required. When the turbines begin to take the load, the latter is divided

between them by means of the regular engine signals "raise" and "lower" and the engine signal whistle.

The field rheostats are left half out of circuit until it is necessary to lower the voltage to keep the load on the turbines within their safe carrying capacity, or to raise the voltage in order fully to load the turbines, except when, in order to balance the power factor, slight adjustment is necessary. In adjusting the voltage care is exercised that the two stations adjust at the same time, so that the power factor is kept balanced. After the turbines have been connected to the bus the engine-driven generators are connected to the system as required. When sufficient generators are connected to carry the load at normal voltage the voltage is raised to normal, and the substation operators notified that they may use their regulators.

In case of total interruption of communication between the substations the following is the procedure: The turbines in Waterside station are started, and observations are made from the feeder instruments in order to ascertain which substations are started. If only a few substations start, the turbines are shut down and after a short wait started again. This procedure is continued until the majority of the substations well distributed over the system, and particularly the larger substations, are started, when the system is restored to normal as mentioned in the foregoing paragraphs.

SUBSTATION EMERGENCY MEASURES.

In case of serious interference with, or a total interruption of the high-tension supply to the substations, the substation operators are required to pick up load on any feeder which is alive, and in those substations which have steam apparatus in commission everything possible is done to get the steam units into operation. In all cases of trouble the three direct-current buses are tied together by closing all the battery switches, and both the auxiliary bus switches are closed on the direct-current feeders, and the station lighting is transferred to the main bus Normal pressure is restored by cutting in all the end cells of the battery if necessary.

If the ammeters on the rotary converters indicate that the supply of high-tension current through any feeder is discontinued, and that the rotaries connected to it are inverted for an appreciable time, the rotaries are disconnected from the high-tension feeders, and the system operator notified. The rotaries are kept running from the direct-current side and in readiness to be synchronized and connected as soon as the system operator notifies the substation operator to that effect, or when the pilot lamp indicates that the feeder is alive. If it is impossible to synchronize in any substation, the system operator is notified of that fact, and arrangements are made to start the rotaries from the alternating-current side.

When the substation operator receives word from the system operator that the alternating-current supply is interrupted and cannot be promptly restored, or in case the generator station is shut down and cannot be reached by telephone, and the pressure on the system has dropped to such a point that the station lighting is no longer useful, the operator is required to open all main bus-feeder switches, and to disconnect all rotaries from the system, and to put the regulators in the low-voltage position. When the system voltage has dropped to about 30 volts each side, all auxiliary bus battery switches are opened, thus disconnecting the battery from the direct-current system, and leaving it available for supplying the station lamps, field circuits of the rotaries and electrically operated switches and relays. The substation operator is required properly to examine all high-tension switches, and to make certain that they opened properly when last operated, since it might be possible that the voltage at the time was not sufficient to cause them to make a complete movement.

When the system operator notifies the substation operator to get ready to start from standstill, or in case of total interruption of communication, the available rotaries that were running at the time of the trouble to the high-tension feeders are reconnected, unless contrary instructions are received. The field circuits of these rotaries are connected to the main bus to which the battery is connected, and the field rheostats are cut in at the "weak" or "all in" position. If the system is at zero voltage, both direct-current legs of each rotary are connected to the auxiliary buses to which the direct-current feeders are connected, the system operator notified, whence the generators in the main station are started. When started in this manner, with interrupted telephone service, if the rotary converter runs inverted for an appreciable time, with a large and increasing load, it is disconnected, as it is possible that the feeder to which the rotary is connected has short-circuited during the trouble.

If the system is not at zero voltage, one leg of each rotary is connected to the auxiliary buses, the regulators are placed in a neutral position and the system operator notified. When the voltage on the rotary is equal to or higher than the auxiliary bus pressure, the remaining rotary switches are closed to the auxiliary buses simultaneously. When the rotaries are under way, the fields are gradually strengthened until the rheostats are about one-half cut out, and when the voltage is high enough to operate the power-factor indicator, unity power factor is maintained.

Except for what slight adjustments are necessary to balance the load between the rotary converters, the substation operators are instructed not to use the regulators until directed to do so by the system operator. When the auxiliary bus pressure is equal to or higher than the main bus pressure, the two buses are tied together. If the rotary rocks, the operator is required to open the field circuit on the discharge clip, and to leave the circuit open a few seconds, whence it may be closed again.

By means of a fire-alarm system of gongs, definite signals are transmitted simultaneously from the system operator to all substations. The signals cover all emergency instructions, and all operators are thoroughly familiar with the code of signals and act in accordance with them. Should other instructions be necessary the substations can be reached by a slower, but quite reliable system of telephones. To be sure, many of the accidents guarded against have not and might never occur; but in order that skill may be acquired in meeting such emergencies, drills are regularly held. It is assumed that the accidents have occurred and the proper precautions are at once taken. In this way every substation is included in a drill at least once a month. To this may be attributed the high efficiency of the operating force.

Practical Operation of the Philadelphia Electric Lighting System.

ELSEWHERE in this issue is published a description of the newest features of the Philadelphia Electric Company's system. In the company's equipment are one main generating station, seven auxiliary generating stations—many of which only carry an arc load, and some of which contain besides transforming apparatus—and nine substations. All of the auxiliary generating stations and substations are connected either directly or through other stations with the main generating station at Christian Street and the Schuylkill River, and it is here that operating interest centers.

The organization of the operating force at Christian Street consists of a superintendent, a chief engineer in charge of the mechanical department, an assistant superintendent in charge of the electrical department, and an assistant superintendent in charge of the alternating-current substations. Directly under the chief engineer are two first and two second assistant engineers, and under the electrical and substation department are four foremen who have general oversight of their respective parts of the system. Short weekly meetings are held to give all these men an opportunity to present matters which are of special importance, and these meetings have been found to be very beneficial.

In the boiler-room all boilers in service are swept down regularly every two weeks by a crew of boiler cleaners. The firemen work in two shifts of 12 hours average and extra men are used over the peak-load periods. Shaking grates are used in the furnaces, which burn soft coal. On account of avoiding as far as possible any excessive smoke and at the same time keeping in

mind the possibility of labor troubles in the fireroom, several types of stokers have been installed by way of experiment. At the present time one bank of boilers is being operated continuously for two-week intervals with the Taylor stoker, upon which a regular series of tests is being conducted to determine its characteristics, due regard being given to its overload capacity, its freedom from smoke, flue-gas analysis under different

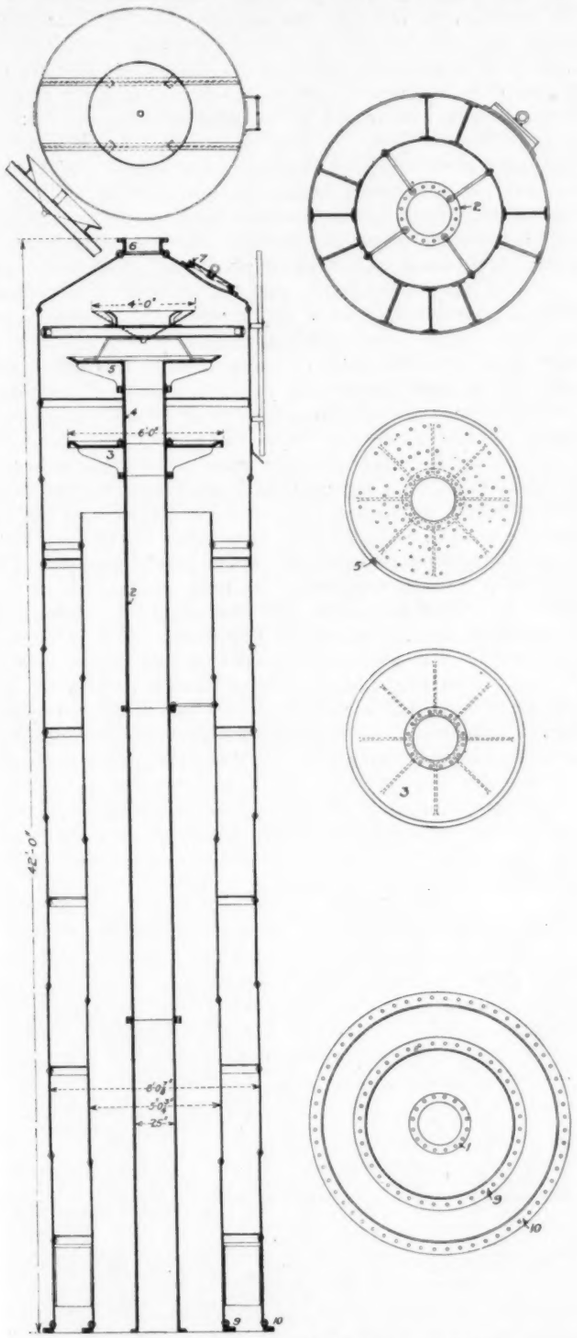


FIG. 1.—DETAILS OF BAROMETRIC CONDENSER.

draughts and degrees of loading, amount of unconsumed coal in the ash, and boiler evaporation per pound of coal.

The average analysis of the coal shows moisture, 1 per cent; sulphur, 1½ per cent; hydrocarbons, 65 per cent; ash, 10 per cent; giving an average equivalent heating value of 14,200 lb.-Fahr. units per pound. A carefully prepared sample is taken from every barge of coal and a copy of the analysis is sent to the shipper.

Boiler-feed water is taken from the river and an analysis is frequently made of the water; caustic soda ash and "cutch" being used in such quantities as may be necessary. A 6-in. connection with the city's water main is provided in case of serious trouble with the water-supply system. All the water piping of the boiler-feed system is heavily galvanized and the main lines are run in duplicate. The screens at the intake are cleaned and inspected carefully every week, being washed off by a hose attached to a small pump.

A complete system of inspection covers in detail every piece of apparatus in the station, each piece being known by a special number. These inspections are made weekly and are reported on inspection cards. On the latter is entered a list of apparatus not in perfect order, and any apparatus marked defective must not appear on two consecutive cards, the card itself constituting a written order for the head of the proper department to have every item mentioned on it put in shape before the next week's report. The daily log book is very complete and forms a minute record of operating conditions.

The last units installed in the Christian Street station are equipped with condensers designed by the company's engineer and embody features of more than passing interest. The condenser, which is shown herewith in detail, is built of ½-in. boiler plate properly stiffened and is mounted upon a special cast-iron exhaust base through which the exhaust steam from the turbine, the injection and the discharge water are separately taken care of. In general, the condenser consists of three concentric openings. The inner tube, extending the full height of the condenser, carries the cooling water, which at the top flows out horizontally over a flat circular perforated spray plate of large diameter and small depth so as to give the largest possible amount of surface for the elimination of air entrained in the cooling water. The 18-in. suction line to the air cylinder of the condenser pump is located directly above the center of this intake column. In order to prevent the splashing or the possible drawing over of water into the air pump in case of trouble with the condenser pump, or otherwise, a steel baffler is securely fastened above the injection pipe and practically midway between that and the air-suction line. External spray plates, also perforated, by their overflow at the edge still further break up the water and allow the air pump to abstract the last vestige of air. The exhaust pipe, which is concentric with the column of injection water, terminates 4 ft. or 5 ft. above the level which would be reached by a column of water from the hot well. Immediately outside of the exhaust steam chamber is the annular space for the descending column of discharge water, the height of which varies with the vacuum in the condensing chamber.

A feature of the system are the new automatic substations of the company. The station at Marshall and Noble Streets requires one operator, who, with suitable hours off for recreation, looks after the plant for 24 hours; the dwelling, which is part of the station, being made his home. All repairs are cared for by an emergency department under the control of the assistant superintendent of substations. All large repairs and construction work are looked after by the construction department of the company, which, under the supervision of the heads of the engineering department, prepares and executes all plans for switchboard extension and construction, as well as for new stations. The station contains only transformer and control apparatus and is entirely automatic in operation.

In only two of the original stations has the 2400-volt, steam-driven machinery been kept in commission; the station at Tacony, which up to the present has been to all intents and purposes a separate part of the 2400-volt system, and the station on Susquehanna Avenue, where some 1500 kw of the 2400-volt, steam-driven apparatus is still available, although very rarely used, being kept to help in case of heavy peaks or for emergency conditions.

The main circuits running from the stations are of No. 0 size, which has been made a standard. The size of the wire used for branches depends entirely upon conditions, but is never smaller than No. 4. Each branch is properly protected by fuses to localize trouble and thus prevent any large number of consumers being affected. The secondary distribution has been given careful study having in view as few transformers as pos-

sible and also furnishing constant potential at the extreme ends of the system, the variation not exceeding 2 per cent. No. 0 wire is used almost exclusively for secondary distribution circuits. In congested districts where large motor installations are encountered as well as large lighting loads, it is the practice to separate the motor from the lighting load. In installations, however, where small motors as well as lamps are in the same building, five-wire, two-phase service is introduced, making it possible to use 220 volts for the motors and 110 volts for the lamps. The arc circuits are made up in groups of 125 lamps, and the layout is such that not only is the amount of wire necessary a minimum, but trouble can be readily located, it being possible in most cases when a circuit is open to close a portion of the circuit immediately and find the break on the remaining part as soon thereafter as possible.

In the operation of the stations, as far as possible, all 6000-volt feeders are connected on one common bus, while at the substations an effort is made to operate the feeders on separate buses. By this means it is thought that the most reliable service may be obained, and the automatic action of circuit-breakers at the substation ends may frequently be cut out temporarily and the circuit-breakers at the main station relied on to take care of any serious trouble that may occur. This circuit-breaker is set so high that it opens only in case of trouble really serious. In this way a great many interruptions of circuits which are not

WEEKLY INSPECTION REPORT—OPERATING DEPARTMENT.

Week Ending_____

Inspection has been made of all machinery, apparatus etc., called for on Inspection Sheet No._____ and, excepting as below, everything has been found in first class operating condition.

Insp. No.	Not in first class condipon—Reason	Insp. No.	Inspection not made—Reason

FIG. 2.—INSPECTION REPORT BLANK.

in trouble are avoided, the defective circuit not being allowed to interfere with the other circuits.

The city of Philadelphia being spread over a considerable area and being free from very congested districts, like New York, for instance, unlooked-for overloads do not come on quickly. The greater part of the city is made up of private dwellings or two-family houses, two stories high. Thunder storms are usually seen approaching from the Christian Street station and provision made for carrying the extra load which the storm might cause to be thrown on the system. Ordinarily the units running can carry the extra load. It is the practice in Philadelphia, as elsewhere, to divide the load among the units so that should one go out for any reason, the others will carry the load without overheating or until another unit can be started.

In training its operators the company realizes that it requires some time to get an efficient force and that because an operator has had experience with smaller systems it does not necessarily suffice when operating a larger system. The company aims to give the operator a thorough knowledge of each piece of apparatus used, as well as an intimate acquaintance with its entire system. The assistant operators, as a rule, are selected from the helpers, and the foremen from the operators. In the mechanical department, the engineers work up through the positions of assistants, pump men, oilers, machinists, etc. The organizing and building up of a piece of human machinery which will keep operating under all conditions in a satisfactory and competent manner has been found by all large operating companies to be equal in importance with the installation of good apparatus and machinery.

Operating Results from a 6000-kw Central Station.

In considering the factors which enter into the cost of producing electrical energy at the busbars of a modern central station it is important to appreciate the fact that plants whose equipments do not represent the latest and most complete practice in all station departments may still afford valuable object lessons. The most modern installation naturally commands widest interest with respect to the economy of production; but the fact that the great majority of stations are still in something of a transition stage emphasizes the necessity of analyzing with care all operating results, and, when possible, of finding out the reasons for the variations in the cost of production.

The following figures of operation are presented as suggestive in the work of a 6000-kw plant which is undergoing a gradual change from obsolete methods of production to more modern standards of generation, covering the results of the past four years. The costs given apply to the expenses of manufacturing at the station and do not take account of any characteristic fixed charges.

The equipment of the station—located on tidewater in eastern Massachusetts—in 1905 was varied. The boiler plant then consisted of 10 Roberts horizontal-return boilers, each having 88 3½-in. tubes, rated at 125 hp, and operating at a steam pressure of 100 lb. per square inch; and two Babcock & Wilcox water-tube units, with 168 4-in. tubes each, the boiler rating being 350 hp in each case with 115-lb. steam pressure. The total boiler horse-power rating was 1950 normal. The engine units of the plant comprised three 24-in. x 42-in. x 48-in. Allis compound engines, running 100 r.p.m., and rated at 900 hp each; one Corliss 20-in. x 36-in. x 48-in. 500-hp engine, making 75 r.p.m.; one Ball engine, 13-in. x 12-in., at 300 r.p.m., 100 hp; and one Allis-Chalmers 24-in. x 48-in. x 48-in. engine rated at 1000 hp at 100 r.p.m. The total engine horse-power rating was 4300 normal and there were 17 dynamos in the plant, many being belt-driven.

The operating force in the station is comprised of 18 men, including four engineers, five firemen and nine engine-room and electrical attendants. Table I gives the total cost of manufacture for the year:

TABLE I.—COST OF PRODUCTION, 1905; STATION RATING, 300 KW.

Kw-hours delivered at station bus	5,498,747
Cost of manufacture:	
Fuel	$30,914
Oil and waste	606
Water	2,987
Wages at station	17,497
Station building repairs	2,018
Steam equipment repairs	3,532
Electrical equipment repairs	2,972
Total	$60,526
Cost of production per kw-hour at busbars:	Cents.
Fuel	.563
Wages at station	.318
Miscellaneous	.222
Total	1.103

These figures show that fuel and labor were the chief items of cost in 1905, and that the station made an excellent showing considering its general design and limitations. The fuel burned in that year was bituminous coal at $3.35 per ton; coke at $3.50; anthracite breeze at $2.50, and tar at $1 per barrel. The principal fuel was the bituminous coal, 6835 tons being consumed by the station. About 10 per cent of the operating cost was steam and electrical maintenance.

In the year 1906 the station output was 6,052,518 kw-hours, of which 2,107,214 kw-hours were sold for electric motor service. The data do not give the power sales for the preceding year. The cost of production per unit in 1906 was 1.415 cents, due to an expenditure of $16,092 for steam-plant maintenance. This portion of the station equipment demanded about 4.5 times as much money for repairs in 1906 as it did in 1905. The com-

pany continued its practice of burning mixtures of fuel. The results of the year are shown in Table II:

TABLE II.—COST OF PRODUCTION, 1906; STATION RATING, 5000 KW.

Kw-hours delivered at station bus	6,052,518
Cost of manufacture:	
Fuel	$38,323
Oil and waste	892
Water	4,150
Wages at station	18,296
Station building repairs	4,488
Steam plant repairs (equipment)	16,092
Electrical equipment repairs	3,623
Total	$85,864
Cost per kw-hour:	Cents.
Fuel	.634
Wages at station	.302
Steam equipment repairs	.266
Miscellaneous	.213
Total	1.415

The station was operated in 1906 by 19 men—i.e., five engineers, seven firemen and seven steam and electrical attendants in the engine-room. Four of the Roberts boilers were disposed of and two new Babcock & Wilcox boilers purchased. The new units each consisted of a 400-hp boiler having 192 4-in. tubes with steam pressure at 115 lb. The Allis-Corliss and Allis-Chalmers engines remained in service as in 1905, but two new units of 500-kw and 1500-kw Curtis turbo-alternators were added. The total number of electric generators in the plant in 1906 was 16. The installation of the turbines was the first step in a policy of modernization which will probably in time result in the elimination of all inefficient steam equipment and belted apparatus. Without having full details of expeditures at hand, it is difficult to fix the responsibility for the heavy steam-equipment maintenance charges which had to be met in this year, and which, in fact, continued through 1907 and 1908, as will be seen in the subsequent data. It is probable, however, that the older steam machinery and mechanical driving apparatus were at a critical point in 1906, and that the heavy cost of repairs was due in part, at least, to the obsolescence and depreciation of the old and out-of-date equipment. The company burned 8367 tons of soft coal in 1906, and the average cost per ton was $3.17. Considerable coke at $3.50 and tar at $1 were also consumed. The figures for the year show that the fuel situation was favorable, but that the station machinery was not in shape to take full advantage of it, since the cost per kw-hour for fuel consumed was over 0.01 cent higher than in the previous year.

The output of the station at the busbars increased in 1907 to 8,216,267 kw-hours. The station was operated with the same boiler equipment as in 1907. The Corliss engines were disposed of this year, leaving a total engine rating of about 6700 hp. There were 15 electric generators in the station in 1907. The operating force consisted of 23 men—six engineers, nine firemen and eight steam and electrical attendants. Mixed fuel was burned, but the largest item was 9884 tons of bituminous coal costing $3.35 per ton. Gas, coal, coke and tar were also consumed under the company's boilers. Table III shows the cost of production:

TABLE III.—COST OF PRODUCTION, 1907; STATION RATING, 5000 KW.

Kw-hours delivered at busbar of station	8,216,267
Cost of manufacture:	
Fuel	$44,727
Oil and waste	1,122
Water	4,032
Wages at station	23,166
Station building repairs	6,166
Steam equipment repairs	14,181
Electrical equipment repairs	5,354
Total	$98,748
Cost per kw-hour:	Cents.
Fuel	.545
Wages at station	.282
Steam equipment repairs	.172
Miscellaneous	.201
Total	1.200

In 1908 the output of the station rose to 8,776,165 kw-hours. The unit cost of production remained substantially as in the previous year, the figure being 1.21 cents. The company added two new Babcock & Wilcox boilers of 400 hp each, and all boilers were operated in this year at a steam pressure of 120 lb. per square inch. The company substituted a 1500-kw Curtis turbo-alternator for the 500-kw unit previously installed. The station was operated by 22 men in 1908, six engineers, eight firemen and eight steam and electrical attendants. The total rating of the steam-generating machinery in 1908 was 8200 hp. In 1907 the company sold 3,008,528 kw-hours for power service and in 1908, on account of the business depression, the power sales dropped to 2,764,508 kw-hours. There were still 15 generators all told in the plant in 1908 at the end of the fiscal year. The fuel consumed included 13,507 tons of bituminous coal at $3.64 per ton, as well as gas, coke and tar. Table IV gives the operating results for 1908:

TABLE IV.—COST OF PRODUCTION, 1908; STATION RATING, 6000 KW.

Kw-hours delivered at busbar of station	8,776,165
Cost of manufacture:	
Fuel	$54,158
Oil and waste	1,030
Water	3,551
Wages at station	25,937
Station building repairs	4,547
Steam equipment repairs	12,932
Electrical equipment repairs	3,993
Station tools and sundries	222
Total	$106,370
Cost per kw-hour:	Cents.
Fuel	.617
Wages at station	.296
Steam equipment repairs	.147
Miscellaneous	.150
Total	1.210

In this year about $4,000 was saved in the smaller items, which offset slight increases in certain of the larger factors of cost. The lesson of the four years is that it pays to watch station economy very closely in a transition period; that the full benefits of improvements cannot always be secured at once, but are dependent upon the completion of a policy of betterment, and that there is a close relation between high expense of equipment maintenance per unit and more or less undesirable station composition.

Economy of Production in Central Stations.

At the Nebraska Electrical Association convention, May 11 to 13, 1909, President E. A. Bullock, of Norfolk, Neb., gave an informal talk on economy of production by central stations. He took as a basis for his talk a letter received from a member of the association who had recently built an entirely new and modern power plant and had discarded entirely the plant before in service. The new plant was designed for relatively high economy as small central stations go. The letter of this member, after a few months' experience in operating with the new plant, called special attention to the fact that about 75 per cent of the cost of giving electric central-station service consists of fixed and investment charges, and that only about 25 per cent is a variable operating charge influenced by economy of station operation. This member called attention also to the fact that the additional investment necessary to install a new power plant and discard an old one calls for considerably greater gross revenue to pay interest on the investment and to make the company's bank balance appear as it should.

Mr. Bullock in commenting on the situation indicated by this letter outlined as a generally safe policy for central stations to follow to make additions to the plant in the shape of modern economical machinery, but as far as possible retain the old apparatus as a reserve and for carrying peak loads. This apparatus is usually more valuable to the company which has it installed than it would be to any purchaser of second-hand apparatus. It affords a reserve and peak-load carrying capacity at the lowest possible investment. Mr. Bullock stated that he is putting in a 200-kw condensing steam turbine as an addition to his plant, with which turbine under full load it is hoped (though not too confidently) that the fuel cost will be reduced to ½ cent per kw-hour. He, however, is keeping all of the old apparatus for reserve.

He also referred to producer gas plants as economical sources of power in Nebraska. These plants are being improved constantly and after the first six months of service can be relied upon to give good service. During the first six months, however, there is much to be learned by the owners and operators. He also spoke of the possibility of putting in a chain grate stoker in his plant, even though it is small for such an installation. He thought that it might make it easier to retain good firemen, especially during the hot weather, as it would relieve the firemen of some hard work. It would not reduce the labor account any. It might also improve the boiler economy.

Mr. H. A. Holdredge, of Omaha, in regard to the use of an automatic stoker in a small plant, expressed the opinion that it might be found hard to handle because of the difficulty of banking fires and of adjusting to changes of load. When the Omaha central station, of which he is manager, changed from hand-firing to chain grates, a reduction of two-thirds in the boiler-room force was made. As to whether any improvement in fuel economy was caused by the automatic stokers, he could not say, because so many other changes were made in the station at the same time.

A member asked a question as to the performance of the Diesel engine using crude oil. Answering this question, Mr. J. R. Cravath, of Chicago, said that this type of engine was capable of producing power at a very low rate per kw-hour and that it was giving excellent service in a number of plants in different parts of the country. One reason this type of engine is not more extensively used is the high first cost, which for the 250-hp units amounts to approximately $120 per kilowatt of capacity. This is so high that it has prevented many stations from putting in these engines. They are necessarily very massive on account of the high compression used.

Mr. Charles C. Smith, of Exeter, Neb., reported having operated in his station a Hornsby-Akroyd oil engine for a number of months past. A mixture of one-half crude fuel oil and one-half gas oil is employed. This mixture costs 4 cents per gallon at Exeter when purchased in car-load lots. There is a slight flickering of the lamps which he says is not noticeable to the ordinary person. The cost of a crude oil engine of this kind is from $60 to $65 per horse-power, as compared with a gas engine and producer outfit, which would cost about $100 per horse-power.

Mr. E. V. Capps, of Blair, called attention to the possibility of increasing the capacity of existing plants by the installation of condensers. He has recently done this in his plant. The installation of condensers increases the capacity of the plant from 15 to 20 per cent, and improves the economy about 10 per cent. The cost of plant per kilowatt of capacity is reduced by the installation of condensers, because the additional capacity is obtained cheaper by the installation of condensers than by the installation of additional non-condensing apparatus.

Grounding the Secondary.

OPINIONS OF CENTRAL STATIONS ON THE SUBJECT.

IN our article in our issue of April 1 Mr. W. J. Canada contributed an interesting article entitled "Grounded Secondaries," in which reference was made to a correspondence with central-station companies as to their experience with grounded circuits. Through the courtesy of Mr. Canada we are enabled to print below a selection from such of these letters as the writers will permit to be made public.

We are led to believe that the grounding of your secondaries is most necessary for the protection of life. In fact, our Canadian Electric Association has come to the conclusion that every lighting company should ground one side of their secondaries; or in case of a three-wire system, to have a neutral grounding.—*The London Electric Company,* London, Ont.

We have an extended experience with the grounded system, which we believe is much preferable to the use of ungrounded secondaries, as the ground absolutely limits the potential introduced into the consumer's premises. We have had no comparative figure as to the cost of plant maintenance with grounded or ungrounded secondaries, and it is our experience that grounded secondaries minimize troubles of all kinds. Our local underwriting interests strongly endorse the use of grounded secondaries. We have no means of ascertaining the public's preference in this matter; it is our opinion that the public in general is not sufficiently well informed to be able to pass upon or even discuss the merits of the two systems. We have adopted the uniform grounding of all our secondaries for the purpose of limiting the voltage which can be introduced into the customer's premises, and thereby reducing the fire hazard and the hazard to life and limb.—*Union Electric Light & Power Company,* St. Louis, Mo.

Our most satisfactory operating condition is with the neutral of our secondaries grounded. This gives the least trouble. It seems it is far safer and the change was made primarily for the safety of the public.—*Chippewa Valley Railway, Light & Power Company,* Eau Claire, Wis.

We have had experience both with the grounded and ungrounded secondaries. Our secondary distribution was entirely ungrounded up to the year 1905, at which time we proceeded to ground the secondaries throughout the whole system. Since then we have had considerably less expense and trouble in the operation of the distribution system. The underwriters are heartily in accord with the grounding of the secondaries from their standpoint, and the reason that we made this change was that we considered it superior to the ungrounded system from the fact that there is less danger to life and property.—*Rochester Railway & Light Company,* Rochester, N. Y.

The grounding of our secondary service has in no way affected the reliability or the cost of maintenance of that service. The object in grounding the service was to prevent the possibility of dangerous voltages upon the wires in our customers' premises.—*Omaha Electric Light & Power Company,* Omaha, Neb.

We distribute with a 2300-volt primary system, transforming to 118-236 volts, three-wire secondary. For some time past we have made a practice of grounding the neutral of this three-wire secondary. So far as we have been able to determine there has been no difference in service rendered the customer between grounded and ungrounded secondaries, and our experience has shown practically no difference between the two systems in maintenance to the plant. The system of grounded secondaries has been of assistance to us in a few instances in locating trouble on our lines, as it has caused our ground detecting devices to indicate when an ungrounded secondary would not have shown any trouble. The public has given practically no attention in this vicinity to the question of grounded or ungrounded secondaries, as we have had no trouble of any sort which would bring this question before the public. We made the change from ungrounded to grounded secondaries in order that we might take every precaution to protect our lines and remove to every extent possible the slightest liability of injury to any person due to defects in our system.—*The Schenectady Illuminating Company,* Schenectady, N. Y.

We cannot say that we have discovered any difference in the maintenance to our system through grounding. The grounded

neutral, no doubt, results in less minor troubles, especially on the consumers' premises. We feel it is generally admitted by the public and underwriting interests that it is favorable to ground the neutral, but that the difficulty usually arises on account of the extreme difficulty in securing a thorough ground. We are gradually working toward the grounding of our secondary distributing systems, as it will increase safety both to life and property.—*The Dayton Lighting Company,* Dayton, Ohio.

We believe that the grounded secondary has given the most satisfactory service to our customers. Necessarily, the addition of a ground wire and means for grounding this wire at the base of the pole implies that much more to maintain and therefore increases the maintenance charges. We believe the grounded system has given the least minor trouble. The grounded system is regarded best by the public and underwriters' interest from the standpoint of decreasing the hazard to life.—*Commonwealth Edison Company,* Chicago, Ill.

The grounded secondary system has given the most satisfactory service to consumers, and the grounded system is regarded favorably by the public and underwriting interests. The change was made to grounded secondaries for safety.—*Edison Illuminating Company,* Detroit, Mich.

Our distribution system up to the present date has operated as two-wire, 2200-volt primary, 105-volt secondary, and we have never made a practice of grounding the secondary. Our experience with this system is that it has given most satisfactory service; we have experienced very little trouble of any kind in its operation, and we believe that it is regarded entirely satisfactory to the city underwriting interests as well as to the public in general. However, at the present time we are changing our distribution system in the underground district, which will be on the basis of 110-220-volt, two-wire, alternating-current, with the neutrals grounded, the system in all respects being similar to an Edison three-wire network.—*Louisville Light Company,* Louisville, Ky.

We formerly had a 2300-volt system but changed this to 4000 volts in order to reduce copper and prevent excessive losses. Our system as now running is 4000 volts between legs or 2300 to ground, using the standard 2300-volt transformer between one leg and ground. The low-tension or 115-volt side is also grounded. We connected to ground to give the added protection that it seems to be agreed by engineers this affords. It is rather difficult to tell which system gave the least trouble, as the old system was in bad shape, but during the last two years has been put in good shape. We have had very little trouble with our present system. The principal reason for grounding the secondaries is as given above—i.e., to keep the primary voltage, lightning and foreign current off the secondaries. Another reason is to be able to connect 115-volt, three-phase motors between two of the secondaries and ground, thus forming a balanced three-phase, 115-volt circuit with two standard transformers, the 220-volt motors being fed from between the three legs of the secondaries which form a balanced three-phase, 220-volt circuit.—*Utah Light & Railway Company,* Salt Lake City, Utah.

We ground our secondary system on water pipes whenever we can, which is in 9 cases out of 10, probably. The city engineer objected at first, but when it was explained to him that it was done for public safety, and in a manner not to injure the water pipes, he withdrew his objections. The advantage of water-pipe ground is shown when horses received severe shocks while standing on wet ground between a ground wire merely driven into the ground, and a water pipe, there being sufficient difference of potential between the two to cause the shock.—*Ottawa Electric Company,* Ottawa, Ont.

From experience we believe the grounded system gives the least troubles. It was adopted by this company for the protection of the consumer. Very few companies have adopted grounding of their own accord, the demands of underwriters and the public having been largely the cause of a change. Nevertheless, all first-class, up-to-date engineers appreciate the advantage of grounding and are recommending it in all cases.—*The Edison Light & Power Company,* Wichita, Kan.

We are running both a direct- and alternating-current service, but only the direct-current circuit is grounded. It is our intention practically to rebuild and rearrange the plant so far as the distribution system is concerned. When this is done we shall use a grounded neutral on both our direct- and alternating-current secondary distribution, and we may also ground the neutral of our primary distribution if we decide to use a 2200-4400-volt system.—*Fall River Electric Light Company,* Fall River, Mass.

Our alternating system originated in a three-phase generator operating 2300 volts, 60 cycles, supplying a suburban and substation territory, the first at 2300 volts, the second with a step-up to 11,000 volts from 2300 volts and step-down at the substation. The secondary circuits consist of 104-208-volt, three-wire system in some districts, and in others 250-500 volts, three-wire. Grounded secondaries are preferred by us in all installations.—*Narragansett Electric Lighting Company,* Providence, R. I.

We have operated with our neutral point on these systems grounded for some years and find it gives satisfactory results. There is no doubt at all in our minds that the neutral point of transformers and secondary distributing systems should be grounded in order to give the best protection to life and property. When this is effectively done, should the primary wire come in contact with the secondary wire, or should the transformer break down from any cause, the high-voltage current immediately goes to ground and blows a fuse on the primary side of the transformer, thereby cutting off the dangerous current. We certainly recommend having the neutral point of 110-230-volt distributing systems grounded.—*The Toronto Electric Light Company,* Toronto, Ont.

This company had been operating 2300-volt single and three-phase system in its several districts without grounds on its secondaries up to about four years ago. At that time, owing to the numerous fatal accidents which were being recorded in the daily press in various parts of the country, it seemed advisable to the company to take advantage of the additional protection afforded by grounded secondaries, and, therefore, arrangements were made for the immediate grounding of all secondary services on the system, with the exception of 220-volt and 550-volt three-phase secondaries used for power purposes. This work was all done at the company's expense, and the installation of these grounds covered a period of approximately 3½ years. With the exception of the additional personal insurance factor for customers, we do not know that there is any difference in the quality of service furnished our customers as between grounded or ungrounded services. Aside from the possible burning out of transformers previous to grounding the secondaries, we have no basis of comparison which would show us whether our maintenance cost has been affected by grounded services. We occasionally burn out a transformer even now, which might or might not be due to the grounding of our secondaries, but it is impossible in some cases to determine what has been the cause of the burn-out, there being no evident reason apparent. We have lost in one or two cases transformers due to the failure of service wires where installed in iron pipe leading down the sides of buildings, this being purely due to indifferent work by the contractor installing these service wires, and should not be attributed to the fact that the secondaries are grounded. We know of no troubles which have occurred other than those above outlined, but owing to the necessity of inspection to make sure that the ground connections are at all times in good condition, it might be assumed that the grounded service connections have given the company slightly more trouble, due to these inspections. Our rules in this territory specify that all new services must be provided with ground wires at the customer's expense, and it is, of course, necessary that some attention and time be given

to see that these rules are complied with. This might possibly be classed as additional trouble or additional maintenance from the company's point of view. We consider that the public, from expressions of opinion and from the entire lack of fatal accidents on our system from troubles due to high pressure on secondary services in buildings, view the company's action in installing ground wires as one which is to be commended, and certainly the underwriting interests in this territory have commented very favorably upon our present practice. Other than individual expressions of opinion, we have no real method of knowing just how the public feel in the matter, but such expressions of opinion as have come to our notice have been exceedingly favorable. In conclusion, we may add that under no conditions would the company go back to the operation of an alternating-current distributing system with ungrounded secondaries, particularly on lighting service. The company is seriously considering some action at this time for the additional protection of its power services, which operate at higher voltage than the lighting service, and if in the future, suitable apparatus can be developed to reduce this hazard, the company will take immediate steps to avail itself of such additional protection as may be devised.—*The Edison Electric Illuminating Company of Boston.*

We have a 60-cycle, 2300-volt, 110-220-volt system with grounded secondaries. We have never operated with ungrounded secondaries, and, therefore, are unable to speak from experience as to which is the better; but our system has been extremely successful with the grounded secondaries, and we have had practically no minor troubles.—*Edison Electric Illuminating Company,* Brooklyn, N. Y.

We cannot say that we have discovered any difference from grounding as to maintenance to our plant or system. The grounding neutral, no doubt, results in less minor troubles, especially on the consumers' premises. It is generally admitted by the public and underwriting interests that it is desirable to ground the neutral, but difficulty is often experienced in securing a thorough ground. We are gradually working toward the grounding of our secondary distributing system, as we feel that by so doing the factor of safety both to life and property is increased.—*The Dayton Lighting Company,* Dayton, Ohio.

We have had extended experience with the grounded system and believe it to be much preferable to the ungrounded system, as the grounding absolutely limits the potential introduced into the consumer's premises. We have had no comparative figure as to the cost of plant maintenance with grounded or ungrounded secondaries, but it is our experience that grounded secondaries minimize troubles of all kinds. Our local underwriting interests strongly endorse the use of grounded secondaries. We have adopted grounding of all our secondaries for the purpose of limiting the voltage which can be introduced into the customer's premises, and thereby reducing the fire hazard and the possible hazard to life and limb.—*Union Electric Light & Power Company,* St. Louis, Mo.

Our conduit system here is a 2400-volt, 220-volt, three-wire secondary system, with the neutral grounded as often as possible to water mains. We find this very successful, and absolutely the cheaper in maintenance, so far as the central station is concerned. Where the service connections are charged against operating it makes it quite expensive as compared to overhead work. The two-wire system, ungrounded secondaries, has given us the least minor troubles, such as short circuits and fuses blowing. The three-wire grounded neutral system is considered the best by the general public and the underwriting departments. In one case the grounding of the secondaries was brought about mostly for the protection of life and limb. All of our overhead two-wire secondary mains are to be permanently grounded (one leg) on all new installations starting April 1, 1909. This additional work is to be done by the contractors equipping buildings, the grounds to be made outside of all service switches and meters, and the connection to the water main to be done by the department when setting the meter. This ground connection is to be No. 4 gage or larger.—*Public Service Corporation of New Jersey,* Newark, N. J.

In Switzerland the practice of a number of central stations is to ground permanently the secondary from transformers, the neutral point being grounded of multi-wire or polyphase systems. We consider grounding desirable from the standpoint of safety to life.—*Technical Testing Bureau,* Swiss Electrical Association.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Chicago Branch N. E. L. A. Delegates Elected by Ballot.

Acting upon the generous offer of the Commonwealth Edison Company, of Chicago, to send two members of the Commonwealth Branch of the National Electric Light Association to the Atlantic City convention, the members of the branch selected their delegates by ballot. There was an exciting campaign, and so much interest was aroused that 80 new members were added to the branch as the result of the election, the membership now standing at 462, being considerably the largest of any branch of the association. The election resulted in the choice of Mr. Ernest A. Edkins, chief clerk of the second vice-president's office, and Mr. John C. Manley, assistant superintendent of the construction department. Mr. Guy Lunn, chief electrician of the Fisk Street station, only failed of election by a few votes. Messrs. Edkins and Manley will accordingly represent their branch at the convention. The Commonwealth Edison Company will also send a strong delegation directly representing the company. The members of the branch appreciated the opportunity of electing two of their members to go to the convention, as it gave some of the younger employees an opportunity which would not have been otherwise available.

Interesting Small Turbine Installation.

The Norfolk Electric Light & Power Company, of Norfolk, Neb., has juts put in a 200-kw De Laval condensing steam turbine driving a two-phase, 60-cycle alternator. This turbine is installed in the company's present steam plant, and will just about double its present capacity as to generating apparatus. Water for condensing is obtained from wells. The plant has heretofore been operated with simple non-condensing engines. This is the interesting station described in our issue of Jan. 21, which has its yearly peak loads during the day in summer. This summer peak is made up of the company's power business, plus flatirons. The power business includes the operation by motor of a neighboring ice plant and the pumping of the city water. It is hoped to bring about considerable reduction in fuel cost by the use of the condensing turbine. This is guaranteed to consume not over 23.5 lb. of steam per kw-hour on full load.

Price of Tungsten Lamps in New York City.

The Public Service Commission on May 18 and 21 granted permission to the United Electric Light & Power Company, the New York Edison Company and the Brooklyn Edison Company

to put into effect immediately a revised tariff making reductions in charges for tungsten lamps. The application was made in conformity with an order issued last December requiring the approval of the commission to any changes in rate schedules. The new rates of the several companies are as follows:

UNITED ELECTRIC LIGHT & POWER COMPANY.

Lamps. Watts.	Customers entitled to free renewals.	Customers not entitled to free renewals
25	$0.48	$0.60
40	.40	.58
60	.75	.75
100	.85	1.10
250	1.75	2.25

NEW YORK EDISON COMPANY.

Lamps. Watts.	Customers entitled to free renewals.	Customers not entitled to free renewals
25	$ .475	$ .60
40	.575	.70
60	.75	.90
100	.85	1.10
250	1.75	2.25

EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.

Lamps. Watts.	Customers entitled to free renewals.	Customers not entitled to free renewals
25	$ .50	$ .60
40	.60	.70
60	.75	.90
100	.90	1.15
250	1.75	2.25

Electric Cooking Demonstration in Los Angeles.

The Edison Electric Company, of Los Angeles, Cal., is giving to the people of that city an interesting demonstration of electric cooking in the San Fernando Building. Mrs. A. M. Colby, of Boston, is the demonstrator, and between 10 a. m. and noon and between 2 p. m. and 4 p. m. daily she shows how easy it is to prepare appetizing dishes by the aid of the appliances in the electric kitchen. A variety of electric cooking utensils and electric appliances of other kinds are shown.

High-Efficiency Lamps and Reflectors.

At the convention of the Nebraska Electrical Association at Omaha, May 11 to 13, Mr. Morgan P. Ellis, of Chicago, read a paper on "The Relation of the Holophane Prismatic Reflector to the New High-Efficiency Units." He called attention to the fact that this class of reflectors for use with tungsten lamps had been recently redesigned so that three new types have been brought out for each size of lamp. These types are known as the extensive, intensive and focusing, the focusing being the most concentrating and the extensive the most widely distributing to the three types. Referring to criticisms as to the effect of dust and dirt in impairing the efficiency of reflectors, he called attention to the fact that dust affects all reflectors alike. The reflecting efficiency of the prismatic reflector is not affected by dust on the upper side.

In the discussion which followed, a question was asked by a member as to the success of the 250-watt tungsten lamp. Mr. George Loring replied that the 250-watt tungsten lamp is now more of a success than in the past, and he predicted that it would be used in large quantities during the next 12 months.

Mr. B. C. Adams, of Lincoln, expressed his belief in the use of units smaller than 250 watts. When small units are used there is not so much inconvenience when one burns out, and the cost of renewals is not brought so forcibly to the user's mind.

Mr. E. A. Bullock, of Norfolk, Neb., condemned the use of an exposed cluster of tungsten lamps surmounted by a flat reflector, as is so commonly used now. He pointed out that better efficiency can be obtained by placing reflectors over each lamp and that this avoids the glare. Mr. Ellis explained why better efficiency is secured by placing an individual reflector over each lamp. He stated that the satin finish on a prismatic reflector reduces the illumination about 15 per cent.

Electric Cooking Publicity in Denver.

During the latter half of the month of April the Denver Gas & Electric Company gave a series of cooking demonstrations which had an average daily attendance of 5000 women. In order to get the lessons the most complete publicity arrangements were made with the *Denver Post*, allowing it to claim the right of bringing Mrs. E. O. Hiller, of Chicago, the demonstrator, to Denver for the benefit of the Denver women. This publication has the largest circulation in the Rocky Mountain region and it has little trouble in making a success of any worthy movement to which it directs its attention. In the Sunday issue preceding the opening of the school the newspaper devoted several columns to the purposes of the demonstration and the result was a packed attendance at the first lesson. It was found that the company's hall accommodations were too limited and the demonstrations were shifted to the ordinary of the Brown Hotel. Although this hall has a capacity of over 1000, it was too small for the large number of women who wanted to take advantage of the lessons, and the company hired the Auditorium where the Democratic convention was held last year. The stage was divided into two rooms, in one of which was every electric appliance for cooking and household purposes; the other room contained gas appliances. There were several electric cooking demonstrations and these were largely attended. One of them was held at night and the Auditorium was packed. Every appliance was thoroughly explained and since the domonstrations their sale has been better than in months. Denver got a great deal of good out of the demonstrations and the company feels that it reached every household of Denver as it could not with any other kind of advertising.

Enterprising Electric Plant Owner.

In response to an inquiry suggested by a rather vague newspaper notice of a new electric lighting plant in a Western town, a communication was received which reveals a spirit of enterprise worthy of being recorded as a lesson to any managers of small central stations who may regard their field as too limited for indulgence in hustle.

"We have installed just a small 12-light plant in our store building for the purpose of demonstrating to our farmer friends what can be done in the way of lighting their buildings on the farm with electricity. We operate this plant with a 3-hp gasoline engine and light our entire building, which has a frontage of 100 ft. and is 60 ft. deep. We use 30 25-watt and 5 60-watt tungsten lamps. That seems like quite a load for a 12-light plant, but it carries it to perfection. We have the wiring arranged so we can switch the lights either on to the city circuit or on to our own plant, thereby giving the customer a practical demonstration of the fact that we have the better light, and that with our little plant he can have better electric lights on the farm than the city folks enjoy. It is easy to demonstrate this to the customers' satisfaction for the reason that when we switch from the city lights to our own we give them a little more voltage. We have the switches arranged so we can cut out a few of the lights at a time to demonstrate the effect on the engine and dynamo of carrying a full load or a part of a load. We try to be up to date in our line, and have added this electric light proposition as an advertisement and as a stimulant to the gasoline engine business.

"We have not given you the data you ask for the reason that we couldn't do so intelligently if we should try, for it is all Greek to us. What we know about electricity wouldn't blot the flyleaf of a very small almanac. We just know this: We have operated this little plant since last November and it hasn't given us a single minute of bother. It is always ready to go and we can have the lights burning in three-quarters of a minute any time. We have learned that it isn't necessary for us to know anything about electricity to operate this plant successfully."

Overhauling Meters and Illuminating Engineering at Beatrice, Neb.

At the convention of the Nebraska Electrical Association, May 11 to 13, at Omaha, Mr. Frank McMaster, of the Beatrice Electric Company, described work he has recently been doing for that company in the way of testing and calibrating consumers' meters and looking over each installation with a view to improving the illumination which the consumer is obtaining. Defective wiring is also noted.

About 800 meters have been tested. They were tested in place on the consumer's premises by comparison with a standard portable recording watt-hour meter. The load is obtained by turning on a number of the consumers' lamps. This incidentally gives the desired opportunity to look over the consumer's installation and note defects and places where the consumer is not getting the illumination which he should for the money he is spending. Blackened lamps are taken out and in many cases the consumer is persuaded to try tungsten lamps in the more important rooms. In many cases the fusible cut-outs were found to be in very bad shape, offering considerable fire risk. Many cut-outs were found which were entirely uncovered and in which various things had been substituted for fuses.

Out of the 800 meters, one case of plain theft of electricity was found. In three cases circuits were connected to the service before it reached the meter, evidently by oversight. Meters were tested at full load and at one-tenth load. Only four fast meters were found out of the 800, the maximum error in favor of the company being 5.5 per cent. The total average of the slow meters was between 3.5 and 4 per cent slow. In correcting meters the attempt was made to get them not over 1 per cent slow and never to leave them fast. He estimated from the result of this overhauling that the company at Beatrice could afford to pay $1 per meter to have each meter put in shape for correct registration.

As to the number of installations which could be gone over in this way per day, he had heard it claimed by one large company that one man could test 20 to 35 meters per day. He was convinced that if any such record were made it must be by "absent treatment" of many of the meters. The average number of installations tested and inspected per day at Beatrice varied from seven to nine. When the company receives a request that a consumer's lighting be inspected it is usually necessary to make such inspection at night, and it is usually feasible to make only two such inspections in an evening. The work described, he said, was not to be considered simply as meter testing, but as a general inspection of the consumer's installation with the idea always in mind that the company is not selling the consumer electricity, but light.

In the discussion of this talk Mr. E. A. Bullock, or Norfolk, said that he had imported an expert last year to test the 500 meters on his lines. These were inducted meters of Westinghouse and General Electric manufacture. Out of these 500 meters 40 were found 30 per cent slow. One meter was found 10 per cent fast, and all the rest were within 10 per cent of correct. It had taken 60 days to test these 500 meters.

Discussion on New Business Topics at Nebraska Convention.

At the convention of the Nebraska Electrical Association, May 11 to 13, parts of several sessions were given to discussion of new business topics. In one session the importance of increasing business where a plant had been rebuilt and has considerable excess capacity was forcibly brought out. In such a case the interest and depreciation charges on the new plant necessitate extra effort to get the plant loaded.

In his presidential address Mr. E. A. Bullock, of Norfolk, suggested the co-operative employment of a good new business solicitor by several small central-station companies. Mr. B. P. Egan, of Nebraska City, endorsed this idea, as did also Mr. E. V. Capps, of Blair.

Mr. H. C. Porter, manager of the new business department of the Lincoln Gas & Electric Light Company, read a paper giving some of the methods used in getting business by his company. As illustrating how a system of following up possible business may benefit a company, he cited the fact that in a period of four months previous to the convention his company had secured and connected 100 prospects in the face of competition of another central-station company in the same field. Mr. Porter thought that in central stations like most of those in Nebraska every employee of the company should constitute a member of the new business department. To illustrate the possibilities for the new business department, he stated that no town in the State is adequately lighted. In most towns gasoline lighting plants are plenty; also individual steam-power plants. To introduce electric power it is often necessary to put in electric motors on trial, but good judgment must be used as to where it is desirable to do this. Comparatively few people are acquainted with applications of electricity to different kinds of work. Show-window lighting offers an attractive field of development for most companies. In advertising do not try to tell too much at once, but have an advertisement tell one thing in a plain and striking way. Since electric-lighting companies sell advertising in the shape of electric signs, such companies should be liberal advertisers in all ways to show their faith in advertising.

Mr. B. P. Egan, of Nebraska City, speaking of the building up of business by means of the tungsten lamp, said that in the first installation of tungstens in his town he had put in 25 40-watt tungsten lamps in place of 25 16-cp carbon lamps. This reduced the customer's wattage slightly, but the increase in illumination was sufficient to be striking, and to attract special attention. He therefore made up his mind as a result of this experiment to adhere to larger units, and his campaign proceeded successfully along such lines. He is now putting in tungsten fixtures as a substitute for arc lamps.

Mr. L. E. Watson, of Beatrice, reported having installed a number of 250-watt tungsten lamps. A dozen of these have been installed in a church since last September without a burnout. Altogether the company has several dozen 250-watt tungstens on its lines giving fine satisfaction. Some have been put in to replace arc lamps and thus the company has saved the maintenance of the arc lamps.

Mr. Joel M. Roberts, of York, said that his company carries a regular advertising space in the newspapers. He makes it a point to see that the paper is supplied with news items as to the improvements and new buildings in town, incidentally mentioning the fact that the house or store has been wired for electric light.

Mr. L. E. Watson, of Beatrice, commented on having seen an advertisement of the Norfolk Electric Light & Power Company which occupied a half-page of a Norfolk newspaper and gave a list of all the motor users in town. He copied this idea in Beatrice and thought that it did the company considerable good.

President Bullock explained that one reason for this advertisement in the Norfolk newspaper was that his company was in the midst of a campaign to secure the pumping of the city water by electricity. The appearance of this advertisement had its effect on the citizens and City Council, because it was naturally reasoned that if so many other concerns found it of advantage to buy electric power the city would find it also of advantage. The city pumping contract was secured after two months' effort.

Mr. B. C. Adams, of Lincoln, suggested that the manager of every small company make it a point to use himself all of the various appliances which he is trying to introduce. In a large city it does not make much difference whether the manager uses these appliances or not, because so few people are acquainted with him and his home. In a small town it is generally known what the manager has in the shape of electric equipment in his house.

Mr. Porter in response to a question as to the way prospective customers are secured, said that the city is divided into five districts, with a man for each district. These men make an actual house-to-house canvass. In this way they get information on the conditions in each house and the gas or electric appliances which the consumer is not using, but might be induced to purchase. Records of these calls are kept in card index and the best prospects followed up.

Mr. Scoutt, of Kearney, said that a card index record of all the buildings in town made up in this way had proved of great assistance to his company in knowing where to direct its efforts for business.

Mr. Smith, of Exeter, reported having 15 washing-machine motors in use in a town of 900 population. President Bullock, of Norfolk, a town of about 4000 population, said that his company paid about $18 per month for newspaper advertising. The popularity of the electric iron and the way it is used were soon learned when there was a temporary shut-down of the plant. The loudest complaints came from those who used the electric iron and who would not iron in any other way.

Electric Talks at Fort Wayne.

The Fort Wayne & Wabash Valley Traction Company has been carrying on for weeks past an interesting campaign to educate public sentiment by means of newspaper advertising. The city of Fort Wayne recently completed a municipal plant for street lighting, and following upon this the city officials began to enter the commercial lighting field by underbidding the Fort Wayne & Wabash Valley Traction Company, which was already in the field. The object of the company's advertising campaign was to convince the citizens of the unfairness to the company and the undesirability to the city of the policy of taking the taxpayers' money to enable the municipal plant to underbid and ruin the business of a private corporation, thereby not only doing the corporation an injustice, but taxing all the people of Fort Wayne for the benefit of the few who obtain low electric lighting rates as a result of this policy. These advertisements appear daily and occupy a space 6½ in. x 12 in. Following is a reprint of one of the "Electric Talks," which has the caption "A Press View of the Facts":

"Is not the entire attitude of the present city administration toward both street and commercial lighting an utterly discredited one?

"Where shall we find an apology for it outside of those who are receiving favors under its reprehensible discriminations?

"Is not the candidate for official honors who presumes on public acceptability of present administrative lighting policies simply inviting public rejection?

"Note what the ably edited, conservative *Fort Wayne News* said editorially May 1, 1909:

"'The citizens generally recognized the fact that Fort Wayne was far behind other cities of the State in the matter of street lighting, yet they made no complaint, for they believed that improved conditions would come with a municipal plant. They rested easy in the opinion that Fort Wayne would show the country how street lighting should be done.

"'But the hopes of citizens have had no realization in fact. Instead of improving upon the contract lighting the city has, if anything, fallen below it, for it has in many instances located lights for political pull rather than with an idea of rendering the best public service.

"'Instead of perfecting the street lighting system as the public expected, the authorities seemed obsessed with the idea of "getting action" on the Traction Company, and to this end the interests of the people of Fort Wayne have been sacrificed.

"'The city has assailed the Traction Company by rushing into the commercial field and furnishing a favored few lights and power at ruinous rates.

"'No schedule has been established and all sorts of rates have been accorded, many of them, it is asserted, below the cost of production.

"'As a consequence of this short-sighted and puerile policy the city stands discredited.

"'It is doing street lighting and commercial lighting, but it is doing neither in a satisfactory or businesslike manner.

"'The service in both departments is discriminatory and unjust and the many are bearing a burden for the benefit of the few.

"'All property owners pay taxes, yet many of them are deprived of the right of a properly lighted street.

"'Moreover, the taxes which all pay are employed in giving cheap light and cheap power to the favorites of the administration. The many do not benefit thereby.

"'The *News* has no desire to place the city administration in an unfavorable attitude, but it maintains that the facts are plain and speak for themselves.

"'Men familiar with business are convinced that the continuance of the present policy means only one thing, and that is the burdening of the people of this city with an onerous tax rate to support a mismanaged institution.

"'The burden is one that is destined to grow greater, too, unless the city faces about, renounces its policy of petty spite and proceeds to develop this light plant as any other business is developed.

"'There is no facing about in proposals to continue present city policies!'"

Power Costs in a 725-kw Central Station.

The following figures of electrical energy cost for the past three years have been calculated from the records of a 725-kw central station, located in eastern Massachusetts about 50 miles from tidewater. The plant is of the reciprocating-engine type and has remained unchanged in the general character of its design for the period under consideration. Its total normal capacity in 1906 was 575 kw. In 1907 a 250-hp engine and 150-kw alternator were added, and in 1908 the equipment remained the same as in the preceding year. During the three years the cost of manufacture, exclusive of fixed charges, varied from 2.88 cents to 2.14 cents per kw-hour delivered at the power-station switchboard. The figures quoted below are of interest, not on account of any notable economy of production, but because they are representative of careful operation under the limiting conditions obtaining, and illustrate the influence of varying factors entering the cost of generation.

In 1906 the equipment of the station consisted of four boilers, three engines and three generators. There were two Allen boilers of the horizontal return-tubular type, each having 124 3-in. tubes, operating at 110 lb. per square inch, and rated at 150 hp each, and two 150-hp Dillon boilers, one having 124 3-in. tubes and the other 92 3½-in. tubes, horizontal type, operating at 110 lb. per square inch. The engine equipment consisted of one Armington & Sims 13-in. x 20-in. x 15-in. engine rated at 250 hp with a speed of 265 r.p.m.; one McIntosh & Seymour 15-in. x 23-in. x 17-in. engine rated at 250 hp, speed, 220 r.p.m., and one 16-in. x 16-in. Ball & Wood engine rated at 211 hp, speed 250 r.p.m. The electric generating apparatus consisted of

TABLE I.—575-KW CAPACITY.
Cost of Manufacture, 1906.

Output at busbars, kw-hours	656,880
Costs:	
Coal, bituminous, 2417 tons at $4.88	$11,799.20
Oil and waste	358.37
Water	246.67
Wages	4,755.90
Station, building repairs	705.89
Steam equipment repairs	670.94
Electrical equipment repairs	436.07
Total	$18,973.04
Costs per kw-hour:	Cents.
Fuel	1.806
Labor	.725
Miscellaneous	.355
Total	2.886

a 175-kw Bullock alternator and two General Electric 200-kw alternators. The operation of the plant in 1906 required the services of six men, including three engineers, two firemen and one oiler. The cost of coal was $4.88 per ton.

The total energy generated in the plant in the year 1906 was 656,880 kw-hours. The company's total sales were 538,910

kw-hours. The output devoted to street and public lighting was 113,449 kw-hours, while the power sales were 226,082 kw-hours. The total cost of generating, exclusive of any fixed charges on the plant and its equipment for the fiscal year ended June 30, 1906, was determined as in Table I.

In 1907 the company added a second McIntosh & Seymour engine of the same type and size as the existing outfit, raising the total engine rating of the plant to 961 hp. A 150-kw Bullock alternator was purchased from the Allis-Chalmers Company and added to the station machinery, the total rating being increased to 725 kw. No additions were made to the boiler plant. The operating force was raised to 10 men, the staff consisting of four engineers, four firemen and two oilers. The station generated 886,800 kw-hours, the total sales being 654,952 kw-hours. The sales of energy for public lighting were 160,827 kw-hours and for power service 340,100 kw-hours. The cost of manufacture was made up as shown in Table II:

TABLE II.—725-KW CAPACITY.

Cost of Manufacture, 1907.

Output at busbars, kw-hours	886,800
Costs:	
Coal, bituminous, 2175 tons at $4.98	$10,836.85
Oil and waste	284.64
Water	222.33
Wages	6,266.54
Station building repairs	286.25
Steam equipment repairs	994.10
Electrical equipment repairs	138.46
Total	$19,029.17
Costs per kw-hour:	Cents.
Fuel	1.220
Labor	.705
Miscellaneous	.215
Total	2.140

In 1908 the company sustained the business losses incidental to a year of financial depression in a moderate-sized manufacturing town, and its power sales dropped to 309,473 kw-hours. The total station energy generated was 889,760 kw-hours, representing a small increase in output at the busbar. The total sales of the company were about 42,000 kw-hours more than in 1907, amounting to 696,494 kw-hours. The principal gain in energy sales occurred in the field of public lighting, the volume being 228,556 kw-hours. The company had to face a serious rise in the cost of coal in this year to $5.31 per ton. The operating force was reduced to eight men, the staff consisting of three engineers, two oilers and three firemen. Table III gives the detailed operating results of the year:

TABLE III.—725-KW CAPACITY.

Cost of Manufacture, 1908.

Output at busbars, kw-hours	889,760
Costs:	
Coal, bituminous, 2299 tons at $5.31	$12,205.05
Oil and waste	224.32
Water	71.43
Wages	6,669.26
Station building repairs	402.63
Steam equipment repairs	1,161.11
Electrical equipment repairs	24.43
Total	$20,758.23
Costs per kw-hour:	Cents.
Fuel	1.370
Labor	.750
Miscellaneous	.220
Total	2.340

Reviewing the operation of the station as a whole during the three years, it is clear that the plant has been handicapped by a rise in coal price of 8.8 per cent, but the improvement in the motor load, so far as it is apparent, was decidedly helpful in decreasing the fuel consumption per unit of output. The station economy, as a whole, is not poor for so small a steam plant equipped with compound engines, although there is evidently room for the betterment of the installation, judging by the coal consumption. The labor costs are rather unsatisfactory, considering the increase in station output, even a reduction in the force giving little relief in the last year of the tabulation. The unit figures in this branch of the station work indicate the importance of making close studies of the attendance in small as well as large stations. It is significant that the steam and electrical equipment repairs amounted to about the same combined total yearly, but that the electrical repair cost steadily diminished. The steady increase in the steam-plant maintenance suggests that in this portion of the station greater care should be taken to secure the best possible efficiency of apparatus.

Twenty-Four-Hour Service in Small Iowa Towns.

At the Iowa Electrical Association convention, April 21 and 22, considerable attention was given to questions pertaining to building up day load in small towns. Mr. M. A. Harrison, of Nevada, gave some of his experiences in the form of a paper. He admitted that local conditions govern the amount of business to be obtained, but the general conditions in the smaller towns of Iowa are similar. In his opinion, there are few of these towns of 2000 inhabitants upward that cannot increase revenues sufficiently to cover the increased cost of giving daylight service.

While it is true most of the small towns have little manufacturing, nearly all have waterworks, printing offices, blacksmith shops, laundries, machine and repair shops, plumbing shops and grain elevators that require power. These, together with the domestic uses of current, and the lighting on during the daytime, will make an aggregate increase in revenue sufficient to offset the expense of daylight operation. Most of the daylight business can be taken on with the present equipment without additional investment.

Mr. Harrison, who comes from Nevada, Ia., admitted that he ventured in the 24-hour service with fear and trembling, but the conditions were such that they felt they must make the effort because of the competition of gasoline plants with the local gas plant. The plant consisted of a Corliss engine belted to a single-phase 60-cycle generator. The company first closed a contract with the city to install motors in the waterworks pumping station, which had previously been operated with steam. A 10-hp motor belted to a triplex pump was used for the first installation and proved a good advertisement and practical demonstration of electric power. The steam laundry, previously located in the central part of town, purchased a building one block from the station and made a contract for electric power and steam for a dry-room and water heating. This was the beginning of the day service.

Nearly 50 electric irons were placed inside of 90 days, much exceeding the company's expectations. As there is only one unit in the station, it is shut down from 6 to 7 a. m. in summer and from noon to 1 p. m. in the winter. At first prospective consumers were skeptical and thought the company could not obtain enough daylight business to justify furnishing the service and would discontinue it, but as the business increased the company was able to take over some of the gas and gasoline lighting which could never have been obtained if day service had not been started.

It was expected that there would be a loss in the daylight operation the first year, but the increased revenue a little more than paid for the extra fuel, space and labor. Day service was started in July, 1907. At present there is 68 hp in motor load connected, consisting of waterworks pumps, grain elevators, blacksmith shop, laundry, plumbers, produce and poultry merchant, printing offices, tailors' irons and 75 domestic flatirons. When day service was first started it was advertised in the two tri-weekly newspapers in the town.

The company put in a stock of motors from 5 hp down and kept them on hand ready to install immediately when wanted. Several gasoline engines were displaced by installing motors on trial besides the engines. In a few instances they had to take the engines as part payment on the motor in order to close the deal, but succeeded in disposing of them at cost out of town. To encourage the use of flatirons, a discount of 20 per cent is given on current used in excess of 8 kw-hours each month. Washing-machines were put out on trial, as well as desk fans and sewing-machine motors. Some people have wired their homes to enable them to get power to operate a washing-machine where they would not have incurred the expense for lighting only.

They have promoted the portable vacuum cleaner by encouraging a man who does housecleaning to purchase a machine and by allowing him free use of the company's show window for a few days in which to exhibit it. The machine is doing satisfactory work and running most of the time. One of the most

effective forms of advertising is that placed on each monthly bill, which is changed each month, and apparently attracts attention of a large percentage of the consumers. One of these advertisements recently called attention to the large number of different kinds of work electricity is performing in the community. The following is a quotation from one of the advertisements recently used on a monthly bill:

"When you turn the faucet and draw a drink of water, did it ever occur to you that it was pumped by electricity? When your clothes go to the laundry, electricity does the work; several are using it in their homes to operate the washing-machine, and for ironing it is unexcelled. It prints the local newspaper, and grinds the coffee for the groceryman; it pumps air to the forge for the blacksmith, and operates the tools for the workmen at the monument shop. Up-to-date physicians are using it in their treatment, the electric heating pad is so far superior to the hot-water bottle, and one of the latest applications is that of assisting the cobbler in repairing shoes. There are many other purposes for which it will soon be used."

Mr. Harrison said that it would have been impossible to have convinced his company that so much day load could have been secured inside of a year, and there is still more to come.

In the discussion of Mr. Harrison's paper, Mr. Flanders, of the Westinghouse Machine Company, called attention to the possibility of using a storage battery for carrying the day load. The battery can be purchased for from $30 to $60 per kilowatt of capacity, and can be used on either alternating-current or direct-current systems. In an alternating-current system a motor-generator set would be required. Mr. H. Coughlin, of Waterloo, brought up the question of fixed charges in connection with day service. If an extra unit has to be installed for day service, as would be the case in many of the smaller plants, the fixed charges on this investment must be considered. Mr. F. L. White, of Traer, said that he handled day load by the operation of a 25-hp engine unit. The large unit in the plant is operated only four hours a day.

Mr. J. T. Moffit, of the Tipton Light & Heat Company, said it was the practice of his company to run half the night up to a year ago. Since then a compromise schedule has been adopted so that the plant is shut down from midnight until 5 a. m. during the winter months and from midnight until 7 a. m. during the summer months, also one hour at noon. Mr. A. W. Zahm told about a plant in a town of 1100 population that started to give day service two years ago. One of the devices which had been pushed to secure a day load in that town was a combination washing-machine and pumping outfit in which one motor can be connected either to drive the washing-machine or to drive the small pump for raising water from the cistern to the tank. These complete outfits, with a 220-volt direct-current motor, cost about $30. Between 40 and 50 have been placed within the past year.

Mr. E. H. Burlingham, of the People's Gas & Electric Company, Chillicothe, Mo., paraphrased John Sherman's famous statement that "the way to resume specie payment is to resume" by saying that "the way to begin day service is to begin." After that go out and get the business. In his experience consumers will not fall over each other trying to get central-station day service. Its advantages must be brought to them repeatedly.

INTERIOR WIRING AND ILLUMINATION

A Striking Sign at Omaha.

The Omaha Electric Light & Power Company recently secured a contract for the lighting of a large sign at Omaha advertising "Old Dutch Cleanser." This sign is shown in Fig. 1, together with a neighboring sign advertising a cigar. Both are flashed signs and are very effective. The Old Dutch Cleanser sign is of particular interest to central-station contract agents because it is the first attempt of the company manufacturing this article to advertise it in this way by the electric sign. It indicates that the Cudahy Packing Company, the manufacturer, is beginning to recognize the value of electric signs for advertising this product, which is already very extensively advertised in other ways. The results from this sign in Omaha will very likely mean the installation of similar signs in other cities over the country. The sign contains about 1000 lamps, half of which are 4-cp lamps and the remainder 2-cp. The order in which this sign is flashed is as follows: (1) "Old Dutch Cleanser"; (2) "chases dirt" (figure of woman with club raised); (3) club falls; (4) entire sign flashed off. On the neighboring sign smoke from a cigar is indicated by flashing the lamps in waves in a very effective way. The cleanser sign is turned on from dusk to midnight. A recent test made by a representative of the Cudahy Packing Company and Mr. I. B. Zimman, contract agent of the Omaha Electric Light & Power Company, showed that practically every person passing a certain point a block away from this sign was attracted to look at the sign in passing. It is 38 ft. high x 54 ft. long, built on an angle iron frame construction by the Thomas Cusack Company, the large billboard and sign concern.

"OLD DUTCH CLEANSER" SIGN.

An Illuminated Interior Sign.

The Denver Gas & Electric Company is using an illuminated sign inside of its general office and salesroom for the purpose of attracting attention to certain seasonable advertisements. It is easily seen either from the street or from the room. It is illuminated with a border of 34 frosted 16-cp lamps, which burn night and day and make the sign stand out so as to be easily seen by passers-by, both night and day. The use of illuminated interior signs in this way is feasible not only for central-station companies, but for their consumers.

INTERIOR NIGHT AND DAY ELECTRIC SIGN.

A Review of Ornamental Curb-Line Illumination.

Mr. D. F. Fradette, contract agent of the Des Moines Electric Company, at the Iowa Electrical Association convention, April 22, in a paper entitled "Ornamental Curb-Line Illumination," told of the post lighting installed on the down-town streets of

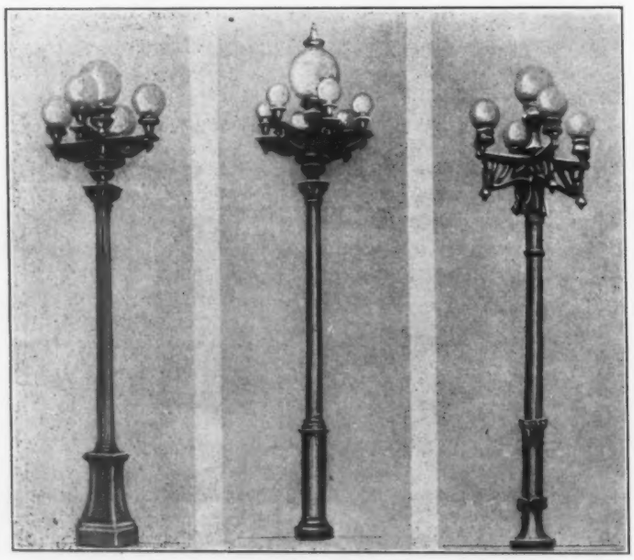
FIG. 1.—WALNUT STREET, DES MOINES.

Des Moines and also reviewed the systems used in several other cities. An abstract of this paper is given below.

DES MOINES.

Mr. Fradette stated that after an investigation, carried on by the local commercial association and the Des Moines Electric Company, the consensus of opinion seemed to be that the post form of lighting is the one most desirable. The post offers less menace to firemen during a fire, and from the standpoint of artistic beauty during the day there is no question as to its superiority.

In Des Moines there is a commercial club, which decided that the city streets should have some form of attractive lighting. With the assistance of the Des Moines Electric Company it decided upon iron poles. The company then got prices and photographs of nearly every type of pole on the market and submitted them to the club, which selected the type shown in Fig. 7. After deciding on the type of pole and probable cost, the matter was taken up with the City Council, which passed an ordinance



FIGS. 2, 3 AND 4.—POSTS, LOS ANGELES, CAL.

making the type of pole selected by the commercial club a standard and specifying that the pole spacing should be not more than 56 ft. nor less than 44 ft. The pole casting costs $59. The total cost set up complete in place and connected is $85.

The electric company, with the assistance of committees of local merchants, made an active campaign. Seventy poles were installed in six months. The more blocks which adopted this scheme, the easier it was to get the rest. The later blocks have been placing poles 16 to the block, or 44 ft. apart, on account of the better effect secured by the frequent spacing. The property owners pay for the poles and the tenant pays for the operation. Each pole has a lock switch in the base and the lamps are turned on by the patrolman when he turns on flat-rate windows

FIG. 5.—SIXTEENTH STREET, DENVER.

and signs. They are turned off at midnight. The rate per year for each pole equipped with five 100-watt tungsten lamps is $69.50. The appearance of Walnut Street at night is shown in Fig. 1.

LOS ANGELES.

In Los Angeles, Cal., the merchants of Broadway organized and installed a type of pole costing $100 complete (Fig. 3). Broadway was later followed by Spring Street (Fig. 2) and Hill Street (Fig. 4). The poles were placed 115 ft. apart on both sides of the street. Each of the five globes contains three 8-cp

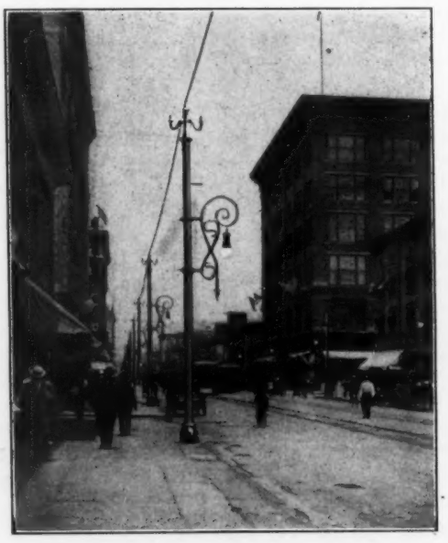


FIG. 6.—FIFTEENTH STREET, DENVER.

lamps. An attempt recently made to use tungsten lamps was a failure because of the jarring from the passing cars. Mr. Fradette notes that no such trouble has been experienced in Des Moines with 100-watt tungsten lamps. A defect noted in the Los Angeles posts is the shading of the middle globe by the outer globes.

OAKLAND.

In Oakland, Cal., a city of 70,000, there are now installed over 600 three-globe posts, each globe containing three 16-cp lamps.

These posts are placed three on each side of the street, six to the block. The cost of each post is approximately $85 set up complete. The solicitation and installation were carried out by a private contractor. The cost of installation was borne by the merchants and the lighting is paid for by the city. In Denver, Col., as a result of co-operation between the street railway, the city and the electric light company, the street-railway poles are used for lamp suspension. On Sixteenth Street (Fig. 5) a square ornamental casing was placed over a steel railway pole.

FIG. 7.—POST, DES MOINES, IA.

FIG. 8.—POST, SUPERIOR, WIS.

These poles are spaced 90 ft. apart, or four pairs to a block. Only one of the arc lamps is used, the other being a dummy. The casing on Sixteenth Street cost $160. The lighting is paid for by the city at a cost of $60 per lamp per year. On Fifteenth Street, Denver (Fig. 6), no casing was used, but an ornamental bracket was placed on a special railway pole. This bracket cost the city only $50. The spacing is the same as on Sixteenth Street.

SUPERIOR, WIS.

At Superior, Wis., a city of 50,000 inhabitants, the publicity committee decided on the system to be installed and did the soliciting. The post adopted is shown in Fig. 8. The street at night makes a fine appearance and denotes a progressiveness which will cause people to stop and investigate the resources of such a city (Fig. 9). The side lamps on this post are 100-watt tungsten, and the top lamp 40-watt tungsten. The poles are wired so that the side lamps may be turned off at midnight and the middle lamp is left burning all night. These

FIG. 9.—STREET LIGHTING, SUPERIOR, WIS.

posts are spaced 55 ft. apart on both sides of the street, or 16 to the block. The cost per post has averaged $80 complete. They are supplied from an independent circuit set in a groove which was chipped in the edge of the cement walk. This system of connecting the poles by setting a conduit in a groove chipped from the edge of the walk seems to be the most popular, but many have done as in Des Moines, namely, fished the wire under the walk and connected to the nearest feeder, each pole being turned on by a lock switch in the base.

Business-Street Illumination by Merchants' Associations in New Jersey.

BY WILLIAM H. STUART.

IT has been conclusively proved in Newark, N. J., that brilliant electric illumination of the business streets will not only draw trade, but will attract it from other quarters not so brilliantly lighted. In Newark the 36 flaming-arc lamps that have been in operation on South Broad Street since Jan. 17 have changed conditions considerably. Where formerly a few hundred people would pass along that thoroughfare, now there are thousands. The increased light has not only brought increased trade, but quite a few new large business concerns as well, and store space in that locality is now at a premium.

The development of this movement and its successful operation are due to the various merchants along South Broad Street who saw that the retail business of the city was monopolized entirely by North Broad Street and who banded together to devise means to attract the trade to their stores. An association, having as members every merchant on that street, was formed and called the South Broad Street Improvement Association. It was soon discovered by discussion that the means to be employed in winning trade dwindled down into one, electricity. The first plan suggested was the greater illumination of the individual show windows, the lamps in which were to be kept burning until a stated hour each night. Inasmuch as all the merchants could not afford to go into it on the same scale as some, and maintain it, the scheme was rejected. The next plan presented was the festooning of the street and shops with incandescent lamps. This was abandoned on account of the quick depreciation of street lighting of this character and the expense of installation and maintenance. Flaming-arc lamps were finally adopted, and, as noted in the Jan. 28 issue, 36 four-carbon flaming-arc lamps of Scott make were lighted amid a public demonstration enthusiastic and appreciative. The spectacle was made all the more enhancing by a heavy fall of snow which cast a reflection that was very beautiful. To the flaming-arc equipment there was added strings of incandescent lamps which were run across the street every 50 ft. This extra lighting was removed after two weeks.

The association after its organization and the final selection of the lighting plan went to the Public Service Corporation and asked for an estimate on the cost of installation and operation of such a scheme of lighting. The Public Service Corporation made a proposition by which it agreed to erect, light and maintain 36 four-carbon Scott flaming-arc lamps along South Broad Street, spaced every 100 ft. on both sides of the street, for the sum of $270 per lamp per year, provided a three-year contract was signed. The lamps were to burn every night all night. The contract was signed and the work on the equipment was immediately started. The merchants' association then made arrangements with the city whereby the association was to pay to the city the difference between the price the city paid the lighting company for the old enclosed street arc lamps, which was $70 per lamp per year. This amount —$200 per lamp per year—is paid by the association in a lump sum to the city, which is responsible for and pays the lighting company. The association placed a subscription list before its members and asked that the total amount be subscribed to take care of the cost of the equipment for three years. Each merchant was allowed to contribute just what he thought the light was worth to him. No trouble was experienced in raising more than enough money to carry out the project. The increased amount of business already done by the various merchants has more than repaid them. Within a short time the association will extend this lighting scheme south on Broad Street and will have an equipment of over 80 flaming-arc lamps. The distance covered will be about three-quarters of a mile.

The success of this venture caused merchants on other streets in Newark to organize and adopt this scheme of attracting business by electric light. It was also taken up by the merchants of other New Jersey cities. In Newark, the merchants

of Market Street are organized into an association known as the Market Street Business Men's Association.

Five of the Market Street business men called a special meeting of the merchants of that street and a permanent association was organized and incorporated. While the principal work of the association is to secure some electric illumination that would attract trade, there are various other improvements to be carried out. The association will place along both sides of the street 68 poles from the Pennsylvania Railroad station to the Court House, a distance of three-quarters of a mile. Two plans were considered. The first one was the use of two single flaming-arc lamps on each pole, one lamp projecting out into the street and the other over the sidewalk. The other plan was the use of one double flaming-arc lamp on each pole. The Public Service Corporation was approached and asked as to the cost of the erection and operation of the lamps. The figures given were, $350 per year per lamp for the double flaming-arc lamps and $300 per lamp per year for the single flaming-arc lamps. The merchants next sought the authorities, with the result that the city entered into an agreement with the Public Service Corporation to light the street with flaming-arc lamps; the municipality collecting the difference in the cost of the flaming-arc lamps and the enclosed arc lamps from the merchants' association. The association in order to raise the necessary funds has used a different scheme than that employed by the South Broad Street Association. A legal contract, which each member is obliged to sign, binds him to pay for the lighting of the street at the rate of so much per running-foot frontage of his establishment. If the merchant fails to live up to the contract he is liable to a suit for damages. This plan, which was approved by all the members, will prevent any of them withdrawing and leaving the others to bear the entire expense. The distance illuminated is measured off in feet and the rate per running-foot determined; but as there are two sides of the street lighted, this amount is halved. It is expected that the cost to a merchant with a frontage of 25 ft. will not exceed $100 per year.

The North Broad Street Merchants' Association has been organized some time, but as the merchants on this thoroughfare have always enjoyed a great amount of trade it has not been found necessary to inaugurate any improvement campaign until now. With business men in other parts of Newark attracting considerable trade from North Broad Street, the association has determined to install a flaming-arc equipment similar to that of South Broad Street. This installation is expected to be in use within a few months. The cost of this installation will be apportioned among the members on the same plan as that adopted by the Market Street Merchants' Association.

In Hoboken, the storekeepers on First Street, from Washington Street to Madison Street, a distance of nine blocks, have formed an organization known as the First Street Merchants' Improvement Association. The membership at the first meeting numbered 36, at the second 70, and at the third meeting, 175. The association approached the city officials some time ago and sounded them on the subject of the city bearing some of the expense of an installation of flaming-arc lamps. The authorities would not go into any flaming-arc-lamp proposition, but agreed to install three additional enclosed arc lamps on each block along First Street if a petition was presented by the merchants for this equipment. The city will bear the expenses of erection and maintenance. The association now has the petition before the City Council. When this equipment is in use it is the intention of the association to install 30 flaming-arc lamps, allowing three lamps to each block. As First Street is a narrow thoroughfare, the flaming arcs will be extended on outriggers from poles to the center of the street. This will give an equal amount of light to both sides of the street. The association feels that the additional arc lamps installed by the city will not show up very well alongside the flaming-arc lamps and will then ask the company to remove them and apply the cost of operating them to the expense of maintaining the flaming-arc lamps. The merchants will pay for this lighting at the rate of so much a running-foot frontage.

The Merchants' Co-operative Association of Jersey City Heights, in Jersey City, which has been organized over two years, has taken up the work of securing an installation of flaming-arc lamps along Central Avenue, from Manhattan Avenue to North Street, a distance of 3500 ft. Thirty flaming arcs will be employed and spaced every 100 ft. diagonally or every 200 ft. on the same side of the street. The association has completed its working plans, which are to make arrangements with the city whereby the latter will make a contract with the Public Service Corporation to light Central Avenue with flaming-arc lamps, removing the present street arc lamps. To pay for this lighting an assessment will be placed on each piece of property along the street, which will amount to about $1.50 per year per foot frontage. The association has already secured the consent of the property owners along Central Avenue to this plan. As this assessment will be placed only on the property along Central Avenue there has been no objection to this plan by the city officials. The lamps will be placed in operation in the early fall to help in the regular annual mardi-gras festival.

As a means of attracting attention to Monticello Avenue, the shop street of the Bergen section of Jersey City, owners of stores along that thoroughfare have organized the Monticello Avenue Business Men's Association, which will direct the campaign of advertising the attractions of the avenue. They have all agreed to illuminate their establishments with electricity at night and pay special attention to their window displays. Monticello Avenue has rapidly developed as one of the big business veins of the city and the association has determined to inaugurate an effective campaign for its improvement by employing flaming-arc lamps in the early fall.

The shopkeepers on Main Street, Paterson, have recently illuminated three blocks of that thoroughfare from Market Street to Broadway. The persons interested, while not as yet formally organized, call themselves the Merchants' Improvement Association. When the idea was conceived it was the intention to have all the merchants brought into an association and to illuminate Main Street for quite a distance, but it was soon found that it would take considerable time to get an extensive proposition under way and the longer the matter was delayed the less the effect would be. The merchants along the three blocks individually agreed to erect 26 Polar flaming-arc lamps. The lamps are placed on outriggers attached to the front of the buildings. The outriggers, wiring and lamps are furnished by the merchants, who also furnish the carbons and provide for the trimming of the lamps. The energy is to be supplied through consumers' meters and a separate meter is set for each pair of lamps. The lamps are lighted each night at dusk and switched off at 11:30 p. m. Unlike the work in other cities, the local merchants' association has not asked the city to help defray the expense, as there are not enough street arc lamps on the three blocks to take into consideration. A month before the present lighting scheme went into effect the lighting company offered to furnish 22 Excello flaming-arc lamps, install them on octagonal wooden poles, with ornamental goose-neck tops and operate them on a three-years' contract at $180 each per annum. This plan had to be abandoned because the city authorities would not permit the erection of the poles and the necessary overhead wiring. Recourse was then had to the plan adopted. The merchants have met with strenuous objections from the Early Closing Association. The clergy, while they do not wish to throw cold water on the method of attracting trade to the city stores, are also up in arms against the illumination, because it will break up the early closing movement by drawing out the people at night and keeping the stores open. The situation at present seems to favor the merchants, who intend in a short time to organize, after which more definite arrangements will be made between the association and the lighting company.

In New Brunswick, about 40 merchants on Bernard Street and Church Street have agreed to the erection of 30 flaming-arc lamps. The lamps will extend for 1½ blocks on Bernard Street and two blocks on Church Street, and will be erected and used under the same conditions as exist in Paterson. The arcs will be operated, two in series, and the energy will be registered

by meter, two lamps to each meter. The lamps, wiring, carbons, trimming and energy will be paid for by the merchants individually. It is expected to have the full equipment of 30 lamps lighted on May 1.

The Progressive Association of Perth Amboy, composed of the tradesmen along Smith Street, will have an equipment of 20 flaming-arc lamps which will be burning in a short time. No plan has been decided upon by the association at present for the erection of the lamps and the payment of the expense. The scheme which seems likely to be adopted is similar to the one employed in Paterson. On the opening night a public demonstration will be arranged with parades and music.

The Public Service Corporation has made a set rate for equipments of this nature, using the Scott lamp, of $300 per lamp per year, including all expenses for the single flaming-arc lamps and $350 for the double lamp. The minimum number of lamps in any equipment is placed at 30.

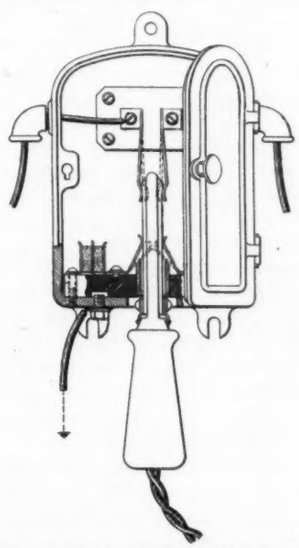
New Telephone Patents.

IMPROVED APPARATUS.

The arrangement of cabling multiple jacks in the multiple switchboard has been standard for many years. In fact, it would seem that the early designers hit upon the only feasible plan permitting the required accessibility. Nevertheless, because of the diminishing size of the jacks, there has been greater and greater difficulty in reducing the vertical dimension of the cables sufficiently to prevent these piling upon the cable shelf faster than the jacks pile in the frames. Flat-type cables have been devised to meet this demand, but, as ordinarily constructed, this type of cable is not of stable shape.

To overcome this difficulty, Mr. W. L. Runzel, of Chicago, Ill., has devised a cable made up of a number of small spherical cables laid side by side with separators between. The whole is then covered with a braiding, which is sewed through from flat to flat, through the separators. This gives a fairly stable construction. Mr. Runzel has assigned his patent to the Runzel-Lenz Electric Manufacturing Company.

For interurban despatching by telephone it is usual to have the telephone carried upon the cars, and to have connections along the line at proper intervals suitable for the attachment of any car telephone to the despatch wire. All sorts of connections have been suggested and used, ranging from the crudest exposed contact devices to the most elaborate jack boxes. Above is shown a jack box for this purpose, patented jointly by Messrs. J. B. Taylor and W. S. Bralley, of Schenectady, N. Y. A flat plug is used with conducting strips on either side of the blade. Considerable ingenuity is shown in the method of sealing the box upon the withdrawal of the plug. The bushing, it will be noted, is so shaped that the protector connection springs come down over it to seal the opening. Another good feature lies in the connection of the protector with the insertion of the plug. This patent is assigned to the General Electric Company.



TAYLOR AND BRALLEY TELEPHONE JACK BOX.

Mr. F. B. Cook, of Chicago, Ill., has patented an individual line protector, in which the fuse links are enclosed in tubular apertures in the base block. To promote reliability of action the fuse wire is crimped so that each length used has exactly the same degree of contact with the walls of the tube. A copper-plated iron wire is used as the fusible conductor.

Another protective device is described in a patent issued to Mr. W. E. Ashby, of Chariton, Ia. This is an adaptation of the old comb-type open-space cutout. The combs are mounted upon a circular base. A tilting knife-blade switch arrangement permits the ready opening of the connection to line and the grounding of the instrument.

There have been invented a good many clever metal boxes or casings for telephone sets, but nearly all of these contemplate the mounting of the transmitter as an entirely separate unit. Mr. C. E. Bilton, of Bridgeport, Conn., however, has pressed up a transmitter front as a part of the front box wall, thus providing for the diaphragm seat and mouthpiece receptacle.

A message-counting device is the subject of a patent granted to Mr. W. O. Weissich, of San Francisco, Cal. The apparatus has a push button actuating an exposed counter. Only a full throw of the button will signal the central operator that a count has been made, and the push button is locked against return to normal at all intermediate positions.

The harmonic ringer has received a good deal of attention and it has been found that this problem is not nearly so simple as it would seem at first sight. This is because of the extraneous effects due to the rebound of the bell clapper from the gongs and to the normal vibration of the bell proper. Mr. Klas Weman, of Buffalo, has patented a ringer which he claims overcomes these features. He supports his armature on a long, flexible rod, this rod paralleling the cores midway between them, and being secured to the yoke end of the magnets. The armature describes a circular motion about this point of support and, therefore, has a sort of sidewise swinging motion, rather than a tilting one. The hammer rod is made flexible so that the vibration is long and free.

It has been found advisable to associate the clearing-out signal with the keyboard keys. This is generally done with lamp signals. Where magnetic signals are used it has, however, not been found so convenient. In order to overcome the difficulties heretofore found, Mr. O. M. Leich, of Rochester, N. Y., has patented a combined ringing and listening key and signal. The device is so arranged that operation of the listening key will mechanically restore the shutter of the signal and thus this latter may be enclosed entirely within a protecting case, having windows for exposing the dial. The apparatus is thus free from danger of accidental derangement in handling the cords. The patent is assigned to the Stromberg-Carlson Company.

A step-by-step lock-out party-line system has been patented by Messrs. R. C. N. Hastings and T. Matheny, of Athens, Ohio. The novelty of this system lies in the fact that the stations are selected off both sides of the line. The normal signaling limb of the line is grounded at the last station, and when a sufficient number of steps have been sent down this limb to ground, to correspond to the last station connected to it, a switching device at this last station transfers the ground to the other side of the line, so that, the next step being sent out, the second limb of the line properly meets ground in order to effect a selection of the sets wired off this side. Provision is also made so that the outermost subscriber involved in any connection may cut off the part of the line beyond him, thus removing the ground connection during conversation.

CLEARING-OUT CIRCUITS.

We recently described an arrangement of condensers to make more positive the operation of clearing-out drops, at the same time reducing the tendency of the clearing-out signal to ring through. Another arrangement has been designed with this same end in view, the joint invention of Messrs K. Weman and T. S. Hemenway, of Buffalo, N. Y. In this invention a high-resistance locking relay is bridged across the cord circuit.

This responds to the first ringing impulse, locks itself and also bridges a low-resistance clearing-out drop across the line. This latter responds to the later ringing impulses, and, being of low resistance, shields the distant bells as well as being positive in action.

Letters to the Editors.

Cost of Water-Pumping in Duluth.

To the Editors of Electrical World:

Sirs:—In your issue of May 6, 1909, on page 1085, in an article by Mr. George J. Kirchgasser, a comparison is made between the cost of pumping water in the cities of Buffalo and Duluth, and it is stated that the price charged the city of Duluth is $6.50 for each 1,000,000 gal. of water pumped. This does not represent the true conditions, as the price to the city ranges from $6.50 per 1,000,000 gal. to $5.50 per 1,000,000 gal. as the quantity of water increases, the higher price being paid when the average number of gallons pumped per day is 1,000,000 and the lower price for an average amount of 15,000,000 gal. These prices, it will be seen therefore, compare very favorably with those charged in the city of Buffalo.

Duluth, Minn. W. N. Ryerson,
General Manager, Great Northern Power Company.

Engineering Classification.

To the Editors of Electrical World:

Sirs:—After reading the article in your issue of Jan. 14 by Mr. George W. Lamke on filing electrical engineering data, it appeared to me that the classification suggested had advantages over others which have been proposed from time to time, and I thought of adopting it for my own use. I find, however, that there are some subjects which hardly seem to fall under any of the headings given. Some that have already occurred to me are as follows:

Electric Generating Stations and Substations.—Descriptive. Specifications and Design. Tests. Management. Cost and Tariffs.

The engineering press is continually publishing descriptions of modern stations, sometimes giving figures and other information of real value. There have also been recently several very valuable papers read before the various engineering institutions covering the whole field of the central station, or one or more of the sub-headings of that subject, which I have enumerated above.

Combined Prime Movers and Generators.—Descriptive. Specifications and Design. Tests.

The technical press contains frequently descriptions of combined generating sets, giving useful figures relating to the mechanical and electrical side individually and *combined,* and I think these might be arranged under the sub-headings given below, in a special section.

Load equalizers—by which I mean devices such as the Ward Leonard, Ilgner or allied flywheel sets and other arrangements for the same purpose—are at present receiving a good deal of attention. It hardly appears to fall under headings No. 35 or No. 36, and it seems worthy of a more important place than No. 38.

It appears to me that there should be some section to include *General Matter* relating to electric drives, such as gearing, couplings, etc., which might be useful in a variety of the many uses to which the motor is put. Of course, any matter relating to special applications should, as far as possible, come under special headings on those subjects, such as locomotives, cranes, elevators, machine tools, printing, etc.

If Mr. Lamke or anyone else can suggest a satisfactory way of amplifying the classifications given in your issue of Jan. 18 last, I am sure their efforts would be highly appreciated by a great number of your readers.

Brymbo, North Wales. T. S. Littleboy.

Locating Wireless Sending Stations.

To the Editors of Electrical World:

Sirs:—The point raised in your issue of April 29 in relation to the location of stations sending wireless messages is of the very highest importance in connection with an important use of wireless telegraphy that is likely to develop, namely, that of helping the rescue of ships in distress at sea. The fact that the *Baltic* was able to go to the rescue of the *Republic* after her collision with the *Florida,* owing to the fact that the wireless operator had the pluck to stick to his signal key and keep on rapping out the distress signal, has interested the whole of the scientific world and the whole of the marine world. It is one important chance in favor of those who go down to the sea in ships. Many of the ships that are never heard of might have been rescued, or at least something might have been known of their fate, if they had been fitted with wireless apparatus, and if the operator had done as Binns did. But, as your comment points out, there is a very weak point in the affair. It is part and parcel of the wireless system, as far as inventors have gone at present, that the signals go out in all directions and there is nothing to tell from what direction they come. In the case of the *Republic*—in the case of any ship in danger of foundering at sea—this is a great advantage, because it makes known the distress to every ship within the radius of the wireless apparatus carried. But, as you have pointed out, it does not make known the position of the ship in distress, and that is a very serious matter indeed. Apart from the difficult task of hunting up the ship, the time occupied in doing so might neutralize the advantages obtained by calling other ships to the assistance of the one in distress. As everyone knows, minutes are often of the very greatest importance in cases of collision. It happened very fortunately in the case of the *Republic* that she was able to keep afloat for a long time, and therefore the rescuing ship had time to reach her, notwithstanding the difficult hunt required. In many cases the question of having to hunt for the ship would render the service practically useless. She would have gone down before the rescuing ship could reach the spot, and possibly leave no trace behind.

There is a very simple method, however, of getting over the difficulty, namely, to signal the latitude and longitude. It should not be difficult, once the matter is called to the attention of the maritime authorities, to arrange a simple code of signals by which the latitude and longitude can be given with a very small number of taps of the signaling key. In view of the small time sometimes allowed to a ship after collision, the smaller number of signals that can be arranged to give these data, the greater will be the chances of rescue. Failing that, however, and until such a code is formed, it would not take very long, and it should be quite easy to signal, after the distress signal, latitude so-and-so, longitude so-and-so. Any ship anywhere in the neighborhood would then be able to make full speed for the spot quite as unerringly and with greater speed than, say, a motor would, if a signal was made from some place on land where somebody was in distress. There is, as seamen will recognize, a weak point to this. In foggy weather the latitude and longitude are no known accurately. Whenever the sun is visible observations are taken about 9 o'clock in the morning and again at noon, the first being for the longitude and the second for the latitude. In addition to this, the ship's course is plotted on the chart, which all ships carry, each distance on any course being marked, and the position corrected from time to time from the observations of the sun. When there is any possibility of the sun being obscured during the day, and it happens that stars or the moon are visible at night, observations are taken of them, of stars for the latitude and of moon and stars for the longitude, the ship's position being corrected by these observations. In the case of ocean highways so much frequented as that between Europe and America, and with the powerful steamers employed in the ocean traffic, the "dead reckoning," as the plotting of the ship's course and distances on the chart is called, will not be very far out, and the position can be obtained at any moment with fair accuracy. If, therefore,

the latitude and longitude were signaled as accurately as could be given from the chart, any ship within range could very easily find the spot or could get within such range of it that the increasing and decreasing power of the signals themselves would act as guides.

In addition to this, having given the latitude and longitude of the ship in distress, if that ship was also fitted with submarine bells, any rescuing ship, which also carried submarine signals, would be able to feel her way to the ship in distress when within a fairly wide range, such as that the approximate latitude and longitude would give her.

BATH, ENGLAND. SYDNEY F. WALKER.

Steam Consumption Tests of a 500-kw Turbo-Generator Set.

To the Editors of Electrical World:

SIRS:—I have read with interest the article by Prof. A. C. Scott on "Steam Consumption Tests of a 500-kw Turbo-Generator Set," which appeared in your issue of May 6.

As the designer of this turbo-generator, which was built by the Allis-Chalmers Company, I wish to point out that the unit described is an enclosed 500-kw, two-pole, 3600-r.p.m. generator, whereas the illustrations in the article show the stator and rotor of an open-type, 1500-kw, four-pole, 1800-r.p.m. generator. Furthermore, the generator installed at the plant of the Water, Light & Power Commission of Austin, Tex., is a modern artificially ventilated generator with inclosure for muffling the noise, whereas Figs. 1 and 2 of the article represent one of the oldest types of turbo-generators of my design.

Professor Scott refers to the metal wedges holding the field coils in the rotor slots and states that these are made of manganese bronze. These wedges are, in reality, made of extruded brass. The rings holding the end connections of the rotor coils are made of chrome-nickel steel and not of nickel steel, as Mr. Scott states. Nickel steel would be utterly unsuitable for these rings.

PITTSBURGH, PA. B. A. BEHREND.

To the Editors of Electrical World:

SIRS:—Permit me to state, in reply to the criticisms of Mr. B. A. Behrend concerning my description of Allis-Chalmers turbo-generator published in your issue of May 6, that the illustration of the stator originally sent to the *Electrical World* with the report of test for publication, was taken from Bulletin No. 1054 of the Allis-Chalmers Company. The illustration sent was correct for the machine tested, but evidently through an oversight, an older type of machine was illustrated in Fig. 1 of the May 6 issue.

It should be evident to one reading the paragraph pertaining to the manner in which the machine is ventilated, however, that the description does not fit the stator shown in Fig. 1, said paragraph being as follows:

"The cool air is drawn in at the sides of the machine by means of fans which discharge it over the end connections of the armature coils into the base of the machine, whence it passes through ventilating ducts in the core to an opening at the top of a cast-iron frame."

The descriptive details concerning wedges for holding field coils in the rotor slots and rings for holding the end connections of the rotor coils were taken from the bulletin above mentioned, dated September, 1908. As the test was made in December, 1908, and the bulletin appeared to be the latest concerned with the type of turbine tested, it was assumed that the statements therein were sufficiently reliable to be used in the description given.

AUSTIN, TEX. A. C. SCOTT.

[The editors are responsible for including the wrong illustrations in Professor Scott's article, which were selected from photographs on hand and hastily assumed to correspond to the engravings in the bulletin referred to.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Motor Converters.—H. S. HALLO.—A paper read before the (British) Inst. Elec. Eng. on what he calls motor-converters (and what is called in Germany "cascade converters," the design being due to Bragstad and La Cour). The converter consists of an ordinary induction motor with wound rotor and a direct-current machine, rigidly coupled and arranged with either two or three bearings. The author discusses the principle, operation and design of this machine. Fig. 1 represents

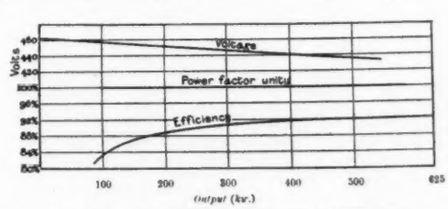


FIG. 1.—CHARACTERISTICS OF CONVERTER.

the characteristics of a 500-kw set. The efficiency, especially at low loads, is remarkably high. Fig. 2 indicates the possibility of an excellent regulation by the shunt rheostat. Sometimes it is required that a motor converter shall be capable of supplying either a traction system at 500 to 550 volts, or a lighting system at, say, 420 to 460 volts. Owing to the great flexibility of the direct-current voltage it is possible to build converters for the above extreme range of voltage, and, as a matter of fact, several such machines with a voltage regulation of as much as 30 per cent are in successful operation. In order, however, to improve the power factor in such a case it is advisable to use a synchronous booster in series with the rotor winding. Motor converters can also be used inverted and also for wire supply. The outer mains in the latter case are connected as usual to the positive and negative terminals of the dynamo, while the middle wire is connected to the star-point of the rotor windings and may be earthed. When large out-of-balance currents are to be dealt with, it is necessary in order not to overload the brush gear of the slip-rings, to use a three-pole change-over switch arranged so that when the switch is down, the three slip-rings are short-circuited and connected to

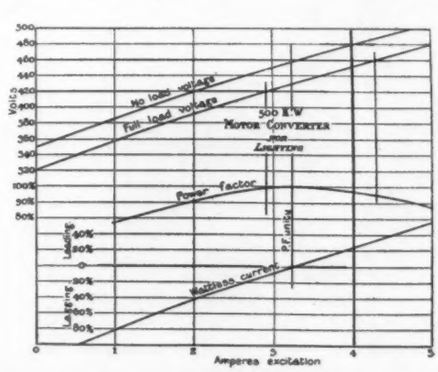


FIG. 2.—EXTERNAL CHARACTERISTICS OF CONVERTER.

the middle wire, so that all brushes on the three slip-rings are called upon to carry the out-of-balance current. When the switch is in the other position the slip-rings are no longer short-circuited, but connected to the alternating-current starter; the switch must be in this position during the starting up of the

converter. A motor converter thus connected up automatically balances the current, and the voltage difference between the two halves does not exceed 1 per cent of the voltage between the outers, with an out-of-balance current of as much as 50 per cent of the full-load current. With 20 per cent out-of-balance current the voltage difference would be well under ½ per cent, and it is thus clear that the balance is excellent and more than sufficient for all ordinary requirements. If, however, it should be necessary to raise the voltage of the heavier loaded half, a series booster must be put in circuit, and driven by the extended converter-shaft. The largest of several converters of this type in operation in British substations is a 1500-kw machine of the three-bearing type of the Manchester Corporation Electricity Department.—Lond. *Electrician,* May 7.

Induction-Motor Diagram.—S. P. Smith.—The first part of an article, illustrated by diagrams, on the application of the no-load and short-circuit diagram of induction motors. The first part of the present paper contains a description of a diagram for induction motors by means of which the efficiency, torque, power factor, etc., can be accurately determined, and an actual example is given showing how the same can be drawn from the no-load and short-circuit currents and losses. The second part of the paper is devoted to a new application of this diagram, whereby the efficiency of induction machines, when tested by the modified Hopkinson method, is accurately obtained for both motor and generator. Lastly, a method for calculating these results is deduced, and checked by means of the diagram. —Lond. *Electrician,* May 7.

Turbo-Commutators.—R. J. Roberts.—A discussion of several points in the mechanical construction of high-speed commutators. The author discusses the kinked form of segment, the method of calculating the shrinkage allowance, the usual method of fixing the balance weights, the construction of lugs and risers, and the question as to the necessity of a spring collar. He thinks that it is not absolutely necessary. A taper is, however, necessary.—Lond. *Electrician,* May 7.

Connection in Parallel of Three-phase Machines.—A. Herrmann.—An article illustrated by diagrams on some special points in comparing phase differences when connecting two three-phase machines in parallel.—*Elek. Anz.,* May 6.

Lamps and Lighting.

Comparison of Lamps.—A. Linker.—A comparative review of the development of new lamps. The author gives the following table of the cost of fuel or electric energy for the different sources of light for one hour and giving 100 hefner-candles:

	Consumption for 100 hefner cp-hours.	Price of fuel or energy in pfennigs (100 pfennigs = 24 cts.).	Cost for 100 hefner-hours in pfennigs.
Stearin candle	920 grams horizontal	140 (per kg)	130
Paraffin candle	770 grams horizontal	155 (per kg)	120
Petroleum	300 grams spherical	28 (per kg)	8.4
Petroleum incandescent lamp	90 grams spherical	28 (per kg)	2.5
Alcohol incandescent lamp	0.25 liter spherical	30 (per liter 90 per cent)	7.5
Gas (ordinary burner)	1,700 liter spherical	16 (per cubic meter)	27.2
Gas (Argand burner)	1,000 liter spherical	16 (per cubic meter)	16.0
Gas incandescent lamp	200 liter spherical	16 (per cubic meter)	3.2
Inverted gas incandescent lamp	160 liter spherical	16 (per cubic meter)	2.6
Acetylene	120 liter spherical	100 (per cubic meter)	12.6
Acetylene incandescent lamp	30 liter spherical	100 (per cubic meter)	27.2
Electric carbon-filament lamp	320 watt hours horizontal	50 (per kw-hour)	16.0
Nernst lamp	150 watt hours horizontal	50 (per kw-hour)	7.5
Tantalum lamp	150 watt hours horizontal	50 (per kw-hour)	7.5
Osram, tungsten, zirconium, Sirius, colloid lamps	100 watt hours horizontal (at 100 volts)	50 (per kw-hour)	5.0
Bergmann, A. E. G., Sonnenlamp, Econo lamps	120 watt hours horizontal (at 220 volts)	50 (per kw-hour)	6.0
Electric arc lamp, without globe	120 watt hours hemispherical	50 (per kw-hour)	6.0
Electric arc lamp, with globe	170 watt hours hemispherical	50 (per kw-hour)	8.5
Enclosed arc lamp	147 watt hours hemispherical	50 (per kw-hour)	7.35
Liliput lamp	90 watt hours hemispherical	50 (per kw-hour)	4.5
Regina and Reginula arc lamps	80 watt hours hemispherical	50 (per kw-hour)	4.0
Helia arc lamp	50 watt hours hemispherical	50 (per kw-hour)	2.5
Quartz lamp	27 watt hours hemispherical	50 (per kw-hour)	1.35
Siemens flame arc, Polar lamp; Bremer lamp, Rebofa flame arc	20 watt hours hemispherical	50 (per kw-hour)	1.0
Mercury vapor lamp (Westinghouse)	20 watt hours hemispherical	50 (per kw-hour)	1.0
Beck lamp	19 watt hours hemispherical	50 (per kw-hour)	0.95
Prima flame arc	15 watt hours hemispherical	50 (per kw-hour)	0.75

(The figures are, however, not strictly comparable, since in some cases the candle-power means the horizontal, in others the spherical and still others the hemispherical candle-power as indicated in the second column. The comparative costs of electricity and gas, on which the figures are based, are according to the third column, 50 pfennigs = 12½ cents per kw-hour and 16 pfennigs per cubic meter or $1.13 per 1000 cu. ft. of gas.) The cheapest and best illumination is by means of arc lamps, at least where lamps of high intensity are needed. For lamps of lower candle-power, gas incandescent lamps are cheaper than metallic-filament lamps if only cost of gas and the cost of electric current are considered. However, the author thinks that the total cost is about the same for both kinds of illumination, besides the other advantages of electric lighting.—*Elek. u. Masch. Betr.,* April 5.

Tungsten Lamp.—A note on a recent British patent of Siemens & Halske Company (17,350, 1908; April 29, 1909). The addition of nickel to tungsten increases its ductility, but lowers its melting point. By adding somewhat less than 8 per cent of nickel, however, and melting, an alloy is produced which is sufficiently ductile to allow of rolling and drawing into fine wire for lamp filaments.—Lond. *Elec. Eng'ing,* May 6.

Power.

Steam Boilers.—J. T. Nicholson.—A paper giving the results of an experimental investigation of the loss of heat transmission from the flue gases to the water in steam boilers. The author believes that there is an exceedingly thin stationary film of gas on the one side, and of water on the other side, which oppose very great resistance to the flow of heat; thus, the use of copper instead of steel, or thin tubes instead of thick, in the hope of obtaining a better heat transmission, is futile. By increasing the speed of gases, however, to 10, or even 50 times, that which now obtains, the cooled films adhering to the surface of the plate are torn off and whirled into the body of hot gases, while new hot films take their places. The communication of heat from a film to the plate is practically instantaneous, and if the cooled films can thus be rapidly replaced, the rate of transfer of heat from the gases to the plate can be enormously accelerated. An evaporation of 45 lb. of water per square foot per hour has been secured by the author by simply increasing the rate of flow of the gases through the flue of a Cornish boiler, beyond the bridge; this was effected by nearly filling up the flue with an internal cylindrical water vessel of boiler plate, leaving only an annular air space 1 in. wide, 40 in. in mean diameter, and 10 ft. long. The heat transmitted through the plates was 34,450 b.t.u. per square foot per hour, about eight times the rate usually obtained, the speed of the gas current being about 330 ft. per second. This experiment shows that the rate of heat transference is directly proportional to the speed of the flow of the gas, and as Rankin's and Peclet's formula takes no account of the speed, it obviously breaks down. The power required to drive the exhausting fan amounted to about 4½ per cent of the whole power available; on the other hand, the output of the boiler was increased to eight times the normal, and there would therefore be a great saving in the cost of boilers, floor space, etc., for equal output. The author has developed a mathematical formula for the heat transmission from the gas flow along the flue. As regarded the bearing of his results upon boiler practice, the author stated that a reduction of the heating surface to even one-tenth of that now usual could be made without increasing the chimney temperatures or

lowering the efficiency. Or if the surface were unchanged, but the cross-sectional area through the flues reduced, a much lower chimney temperature and higher efficiency could be secured. Draughts of 10 in. or 20 in. of water gage, induced by fans, should always be employed for economical working. If the boiler were designed on the economizer principle, with strict attention to counter-current methods of flow, a chimney temperature of 100 deg. to 150 deg. Fahr. could be attained, corresponding to a boiler efficiency of over 95 per cent. Thus, the margin of additional evaporation more than covers the power required for the fan, and therefore higher economies are attainable, with smaller boilers, less floor space and lower costs than at present. Combustion could be carried on in a lined chamber, ensuring perfect smokelessness. The author believes that the proposed new method of working is capable of effecting radical improvement in steam-boiler practice, without which the steam engine cannot retain its pre-eminence in the economical production of power.—Lond. *Elec. Review,* May 7.

Power from the Sun's Heat.—Two illustrated articles, one describing recent experiments by Shumann on utilizing the heat from the sun for producing power. The other article, by H. E. Willsile, gives a review of experiments made by him and J. Bogue. Both articles are profusely illustrated.—*Engineering News,* May 13.

Ontario.—L. DRAKE DEL CASTILLO.—A review of the water powers of the province of Ontario, Canada.—*La Lumière Elec.,* May 1.

Traction.

Single-phase Railway.—The first part of an illustrated description of the railroad from Rotterdam to Haag and Scheveniggen in Holland, which has a total length of 20 miles (track length, 45 miles) and is operated with single-phase current at 10,000 volts. Three-phase currents are generated at 5000 volts and 25 cycles and are transformed by the Scott arrangement into two-phase currents at 10,000 volts. The line is divided into two parts, electrically separate from each other and connected to the two phases.—*Elek. Zeit.,* May 6.

Single-phase Railway.—A fully illustrated article on the conversion of the New Canaan branch from 500-volt, direct-current to 11,000-volt, single-phase operation. This branch of the New York, New Haven & Hartford Railroad, 7.66 miles long, was equipped with the 500-volt, direct-current overhead trolley about 10 years ago for passenger service only, and was converted about one year ago to the 11,000-volt, single-phase system. Current is supplied from the main power station at Cos Cob, and the results demonstrate the adaptability of the single-phase system for branch line electrification.—*Electric Railway Journal,* May 15.

Installations, Systems and Appliances.

Rating and Cost of Steam-Electric Stations.—H. M. HOBART.—The first part of an article giving a great number of tables of estimates. The rating is based on the following specification: "The sets shall be capable of dealing with 25 per cent overload for one hour, and with 50 per cent overload for five minutes without detriment to any part. When continuously operated at the rated output, no accessible part of the electric generator shall sustain a temperature rise, as thermometrically determined, of more than 40 deg. C. above the temperature of the engine-room, in the neighborhood of the generating set." The following table is then given as representative for the cost of complete electric stations (1 £ = $4.90):

Aggregate rated capacity of generating sets installed.	Cost of complete station in £ per rated kilowatt of all generating sets installed.	Total cost of electricity supply station in £.
48,000 kw.	14	671,000
24,000 kw.	15	360,000
12,000 kw.	16	192,000
6,000 kw.	18	108,000
3,000 kw.	21	63,000
1,500 kw.	25	37,500
750 kw.	30	22,500

Tables are then given showing how much of the generating plant is to be considered as spare plant for differing load factors; the difference is the maximum load for which the station is designed. The following table gives the capital cost of generating plants for differing load factors:

Aggregate rated capacity of generating sets installed, kw.	Capital cost of complete generating station in £ per million kw-hours output per annum for following load factors.						
	1.00	0.80	0.60	0.40	0.30	0.20	0.10
48,000...	2,110	2,560	3,330	4,860	6,340	9,290	18,200
24,000...	2,280	2,820	3,660	5,360	6,950	10,100	20,000
12,000...	2,480	3,050	3,920	5,860	7,600	11,200	21,700
6,000...	2,860	3,460	4,560	6,750	8,780	12,850	25,000
3,000...	3,420	4,170	5,440	8,000	10,500	15,400	30,000
1,500...	4,800	5,100	6,630	9,680	12,700	18,800	36,800
750...	5,450	6,400	8,150	11,900	15,400	22,800	45,100

The interest on this capital outlay and the annual outlay necessary for overhauling and for repairs and for new plant, as the old requires from time to time to be discarded, may be covered by the term "annual capital expenses." This is assumed as 10 per cent, so that one-tenth of the figures given in the preceding table represents the annual capital expenses in pounds sterling per 1,000,000 kw-hours for the different load factors. The article is to be continued.—Lond. *Elec. Review,* May 7.

Storage Battery.—A description of a battery to be installed in the Dickinson Street generating station of the Manchester Corporation, which will be the largest storage battery in England. It is to be employed to use the surplus power of the traction generators to assist in dealing with the peak of the lighting load, and at the same time to deal to some extent with the traction peaks. The battery will consist of 210 cells in series, and is to maintain with one of the boosters a voltage of 450 across the lighting busbars. When required for traction service two of the boosters will be run in series. Charging will be carried out from the 525-volt traction busbars. The following discharge rates are guaranteed: 8400 amp for 1 hour; 5000 amp for 2 hours; 3900 amp for 3 hours, and 11,200 amp for half an hour. It is further to withstand a maximum discharge rate of 15,000 amp. The normal charging rate is to be 4100 amp, and the maximum charging rate 6500 amp. The weight of each cell will be about three tons, and the total floor space occupied by the battery will be about 5800 sq. ft. The three boosters will be of the reversible type. Each set is to consist of a motor driving one booster. The boosters will be separately excited, and are to have laminated field systems to allow of rapid reverse.—Lond. *Elec. Eng'ing,* May 6.

Wires, Wiring and Conduits.

Failure of Transmission Tower.—E. DURYEA.—An illustrated article on the failure of a portion of a steel tower electric transmission line in California.—*Engineering News,* May 13.

Distribution of Currents in Networks.—G. MATTAUSCH.—The first part of a paper profusely illustrated by diagrams on a simple method of determining the distribution of the current in an electric network consisting of many branches.—*Elec. Anz.,* May 2.

Electrophysics and Magnetism.

Elementary Quantity of Electricity.—F. EHRENHAFT.—A description of a new method for determining the smallest quantity of electric charges carried by ions or atoms. The author has already shown that there is a phenomenon in gases quite similar to the Brownian movement in liquids. If a direct-current arc of 40 volts and 3 amp or 4 amp is passing between metallic electrodes of 0.5 cm diameter under a closed globe, exceedingly small particles of metals or combustion products remain suspended in the air. If they are drawn by suction before a microscope or ultra-microscope and then subjected to the action of the homogenous electric field of a small condenser it is found that these little metallic particles (silver, zinc, platinum, etc.) obey the laws of electrostatics. When the electric field is established by closing the circuit of the condenser, part of the particles is seen to travel toward the anode, others toward the cathode, while some remain at rest where they are. It therefore seems that the first two groups of these particles are charged with quantities of positive and negative electricity. On the basis of this observation, the author has made a series of measurements which appear to show the existence of large ions

which carry electric charges. Their mechanical mass can be determined by observation with the microscope of their fall in the gravitational field of the earth. Their electric charge can be found by observing with a microscope their mobility in an electrostatic field. Their charge is identical with that of univalent ions and the value is in good agreement with the value which follows from Planck's radiation theory and is one-half the charge of the alpha particle measured by Rutherford.—*Phys. Zeit.*, May 1.

Electric Origin of Molecular Attraction.—W. Sutherland.—A highly theoretical paper on some fundamental difficulties in the theories of electric origin of molecular attraction. According to the author an hypothesis advanced years ago by Fessenden seems, when suitably interpreted, to be justified by a discovery of Mills, made also in this country, though both ignored fundamental physical difficulties in obtaining their results. To account for the facts it is proposed to look upon atoms as electrized, just as we speak of a magnet as being magnetized. But an electrized molecule causes the whole of its domain to be electrized as if for a given chemical substance each molecule possessed an invariable amount of positive electricity and an equal amount of negative and as if these amounts were uniformly distributed through the domain of the molecule, whether its state is gaseous, liquid, or solid. This statement applied only to considerations respecting the total potential energy of molecules. In other words, as regards total energy each molecule behaves as if it had an electric moment proportional to the linear dimensions of its domain.—*Phil. Mag.*, May.

Electron Theory and Induction Currents.—R. J. A. Barnard.—A mathematical paper on the direct application of the electron theory to induction currents. If electrons are moving about in a conductor, even when no current is flowing, an electromagnetic force is acting on each electron when there is an external magnetic field. But since the electrons are moving in such a case impartially in all directions, there can be no resultant effect produced by these forces. Even if a current is flowing, the resultant effect of the electromagnetic force will be perpendicular to the conductor; and, therefore, if the electrons cannot escape from the conductor, no effect on the current, except the Hall effect, is produced in this way. But if the conductor is moved bodily, the motion of the positive and negative electrons so produced will cause a component electromagnetic force on the positive electrons to act along the conductor in one direction and on the negative in the opposite. These forces drive the positive electrons in one direction and the negative in the other, so that their effects add together and produce the induction current. The motion of the secondary circuit in a fixed field is first mathematically discussed, and it is then pointed out that the idea of relative motion naturally gives the same expression for the e.m.f. when the circuit is fixed and the field varying. But the force acting is no longer the electromagnetic force in the ordinary understanding of the term, but an electric force.—*Phil. Mag.*, May.

Röntgen Rays.—C. G. Barkla and C. A. Sadler.—An account of an experimental investigation in which the authors investigated the laws governing the absorption of Röntgen rays, by the use of homogeneous beams of X-rays varying considerably in penetrating power.—*Phil. Mag.*, May.

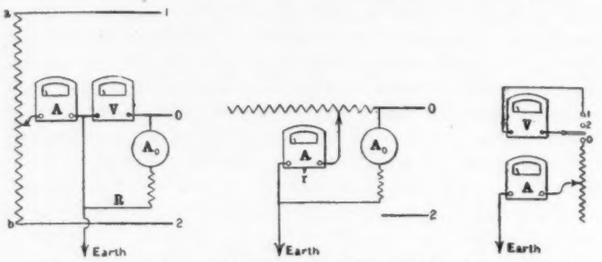
Condensation of Radium Emanation.—E. Rutherford.—An account of an investigation of the condensation of radium emanation and of experiments with liquefied emanation.—*Phil. Mag.*, May.

Electrochemistry and Batteries.

Alternating Current from a Galvanic Cell.—W. Kistiakowsky.—A description of a peculiar galvanic cell which gives current with a periodical change of direction. As electrodes, the author uses iron sheets 0.2 mm thick, and 0.2 cm to 7 cm broad. They are suspended in the electrolyte to a depth of 3 cm to 4 cm. The electrolyte is a chromic acid mixture of a certain concentration, prepared by mixing equal volumes of an 0.2 normal H_2SO_4 solution and a $K_2CR_2O_7$ solution saturated at 18 deg. C. When such a cell is closed through a voltmeter with a zero point in the center, the needle is first deflected to one side to +0.4 volts and then returns, and after 5 or 10 seconds the needle is deflected to the other side to −0.4 volt. It then returns to zero, is again deflected to +0.4 volt and so on. This may go on for hours. This phenomenon is connected with the periodic phenomena observed by Ostwald with the solution of chromium.—*Zeit. f. Elektrochemie*, May 1.

Units, Measurements and Instruments.

Insulation Measurement of a Live Three-Wire System.—G. Kapp and D. Coales.—An illustrated description of various methods of testing the insulation resistance of a three-wire network during working. The first method is indicated in Fig. 3, in which *a b* represents a potential slide the resistance of



FIGS. 3, 4 AND 5.—MEASURING INSULATION OF LIVE WIRES.

which need not be known. The ends are permanently connected to the outer wires 1, 2, and the slider is connected through an ammeter *A* to earth. The middle wire is connected through a voltmeter *V* of resistance ρ to earth. *R* is the usual earthing connection with its ammeter *A*. To measure the total fault resistance, push the slider into such a position that *A* reads zero, and note the reading of *V* which will be called *e*. Then push the slider into such a position that *V* reads zero, and not the reading *i* on *A*. The fault resistance is then

$$f = \frac{e\rho}{i\rho - e}$$

The second method is indicated in Fig. 4. The middle wire has, besides its usual earth connection, a connection with a graduated resistance with sliding contact, and the latter is connected to earth through a low-reading milli-ammeter, say, of 1 ohm resistance. To make a test, set the slider so that the pointer of the ammeter reads a little under half its total range, and note the corresponding resistance in circuit between the slider and the middle wire. Let this be ρ and the current *i*. Then shift the slider so as to reduce the resistance to such a value $\rho_1 =$ that the current is exactly doubled. This will bring the pointer to near an end of the scale. Thus both currents can be read with great accuracy. If *r* is the resistance of the ammeter, the combined fault resistance is

$$f = \rho - 2\rho_1 - r.$$

In a third method, which permits ascertaining the individual fault resistances of the three mains, a slight variation of the difference of voltage between the two sides of the system is made use of. The (British) Board of Trade permits a variation of 4 per cent in the voltage. If the normal voltage is 250 on each half of the system, unbalancing is permitted so as to get 240 volts on one side and 260 volts on the other side. Fig. 5 represents the apparatus used for the purpose. The outer wires are connected to the terminals 1, 2, and the middle wire is connected to 0. *V* is a voltmeter capable of reading the pressure between the two outer wires. It is provided with a switch so that it may also be used to measure the pressure between one outer (say, the wire 1) and the middle wire. *A* is the low-reading ammeter used in connection with the test according to the method 2 described above, but its series resistance is not altered during the test. The pressure between the two outer wires is kept constant, but the voltage on one side of the middle wire is increased, and on the other side decreased by 8 per cent, as explained above. If *K* is the combined conductivity of the three faults and the ammeter with its series resistance, if E_1 and E_2 are the original voltages on each side of the system, and E_1' and E_2' the altered voltages, then the conductivities of

the three faults will be as follows, c applying to the middle wire:

$$c_0 = c - K\frac{e-e'}{E_1'-E_1}$$

$$c_1 = K\left(\frac{E_2}{E}\frac{e-e'}{E_1'-E_1} - \frac{e}{E}\right)$$

$$c_2 = K\left(\frac{E_1}{E}\frac{e-e'}{E_1'-E_1} + \frac{e}{E}\right)$$

E is the voltage across the outers, e and e' are the voltages between the middle wire and earth, and c is $c + c_2 + c_0$, known from the test made according to the second method. The test need not be made at the switchboard, but can be made at any point on the system. The accuracy of the determination of the fault conductivity depends upon the determination of the small differences between the large voltages E_1' and E_1. To render this measurement sensitive two methods are suggested: (a) in which a voltmeter having an initial spring tension, and, say, of 10,000 ohms resistance, reading from 230 volts to 270 volts, is used; (b) in which a low-reading voltmeter is connected to a sliding contact on a slide wire connected to the outer mains, the other terminal of the voltmeter being connected to the middle wire. Both these methods are described and illustrated. —Lond. *Elec. Eng'ing*, May 6.

Stroboscopic Slip Counter.—G. KAPP.—A modification of the well-known stroboscopic disk, the object being to facilitate the observation. The arrangement is shown in Fig. 6. The disk S

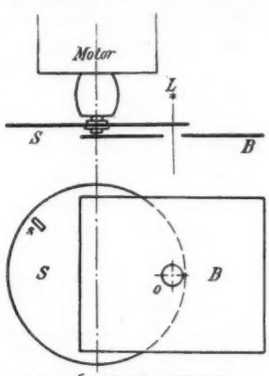


FIG. 6.—SLIP COUNTER.

is revolved by means of the motor. L is an arc lamp connected to the primary terminals of the motor. The greater part of the disk is screened off by means of a screen B. Both the disk S and the screen B are black. A small hole o is left in the center of the screen B and a transparent paper is pasted over this hole. A small slit s is cut near the periphery into the disk S. Whenever the slit s passes before hole o, the light of the arc lamp passes through s and lights o up. The method of observation is to count the light flashes of o. If a is the number of light flashes in the time t, then the slip in per cent of the primary frequency n is

$$a = \frac{100}{n} p \frac{a}{t}.$$

Since it is easy to count up to 180 light flashes per minute, it is possible, even with a two-pole motor and with a frequency of 50 cycles, to determine the slip accurately if it is not above 6 per cent. For motors with more poles, even a larger slip can be accurately measured. The author tried to replace the arc lamp by a metallic-filament lamp. But even with a metallic filament in an atmosphere of hydrogen, its thermal inertia is too great to show periodic light flashes at 50 periods.—*Elek. Zeit.*, May 6.

Excess Load Meter.—A note on a recent British patent of H. Aron (21,576, 1908; April 29, 1909). A meter is described which only begins to register when the load exceeds a certain limit. It is a motor-driven meter, the driving torque of which is opposed by a spiral spring. When the torque of the meter exceeds a predetermined amount, the shaft is rotated; and to allow of its continuous rotation the spring is released automatically after each rotation. Small weights are lifted successively by a rotating portion of the meter so as to keep the backward torque as uniform as possible, and are arranged so that the backward torque is reduced to zero by a very small backward movement of the meter, thus rendering the locking of the meter drive against backward movement unnecessary.—Lond. *Elec. Eng'ing*, May 6.

Testing Instruments.—C. A. HOBEIN.—In testing alternating-current switchboard wattmeters or ammeters it is customary to arrange a lamp bank or suitable current transformers in order to obtain the desired variations in load. The author describes a simple and light device which will vary the current through any range desired. On most switchboards 110-volt, alternating current may be obtained either from the lighting circuit or from the secondary circuit of potential transformers used to operate voltmeters or wattmeters. A small transformer with 110-volt primary and 2-volt to 4-volt secondary is required. As most instruments are now wound with 5-amp current coils the transformer needs a capacity of only 20 watts in order to give maximum load on a wattmeter, or maximum scale reading on an ammeter. In order to vary the current it is necessary to have a resistance. This can be made by winding some iron wire on a cylindrical piece of slate or wood covered with asbestos. By connecting the resistance in the circuit as shown in Fig. 7 the flow of current can be regulated as desired. T is the 20-watt transformer, S is a standard ammeter, and A the ammeter to be tested. R is the resistance, B is a rod of copper or brass supporting the slides S_1 and S_2. S_1 is insulated from B by means of a bushing F, while S_2 is in contact with B. It will be seen that large variations can be obtained by moving slide S_1, while small variations can be obtained by moving S_2. This apparatus is portable. The amount of current desired can be quickly adjusted.—*Electric Journal*, May.

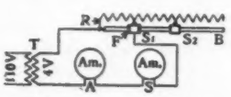


FIG. 7.—TESTING INSTRUMENTS.

Self-Demagnetizing Factor of Bar Magnets.—S. P. THOMPSON AND E. W. MOSS.—Their complete illustrated paper read before the Lond. Physical Society on the self-demagnetizing of bar magnets. The paper consists of three parts: (1) A discussion of the significance and definition of the self-demagnetizing factor of magnets in general, and of bar-magnets in particular; (2) a redetermination of the values of the self-demagnetizing factor for bar magnets of circular section; (3) a determination of the values for the self-demagnetizing factor for bar magnets of rectangular cross-sections of various proportions.—*Phil. Mag.*, May.

Wehnelt Interrupter.—H. KOST.—The anode of the Wehnelt interrupter is usually made of platinum or nickel. The present author makes it of carbon covered with a layer of copper. The thickness of the copper layer determines the permissible current. The construction of his interrupter is described and illustrated. —*Elek. Anz.*, April 18.

Relays.—H. J. REIFF.—An illustrated article describing several forms of relays, based on the principle of the capillary electrometer.—*Elek. Anz.*, March 28.

Pinch Effect and Wehnelt Interrupter.—P. BARY.—The first part of an article in which the author endeavors to show that the operation of the Wehnelt interrupter can be explained completely by the electromagnetic pinch effect.—*La Lumière Elec.*, May 1.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—J. A. FLEMING, G. B. DYKE AND H. W. RICHARDSON.—Their complete three (British) Physical Society paper abstracts of which have already been noticed in the Digest. They deal with the production of steady electric oscillations in closed circuits; with a method of testing wireless telegraph receivers; and with the effect of an air blast upon the spark discharge of a condenser charged by an induction coil or transformer.—*Phil. Mag.*, May.

Wireless Telegraphy on Board Ship.—MEISSNER.—An editorial in which the equipment of the large German steamers with Marconi apparatus is deprecated and the use of the apparatus of the German companies (Telefunken, etc.), is advocated. —*Elek. Zeit.*, May 6.

Miscellaneous.

Tantalum.—A. Siemens.—A lecture before the Royal Institution in London on tantalum and its industrial applications. The lecturer first dealt with the physical and chemical properties of the metal and showed that at ordinary temperatures tantalum was unaffected by all acids (except fluoric), alkalies and moisture. He also showed that it was an ideal material for mechanical apparatus and for implements, which, if made of steel, would be liable to rust. As regards physical properties, it was tough and malleable, so that it could be drawn into fine wire or hammered into thin sheets. Nevertheless, it was quite elastic, and as hard as soft steel, its tensile strength being 27 tons per square inch. The filament used in tantalum lamps was 0.03 mm in diameter and should, therefore, support a weight of about 80 grams. Tantalum was also being used for making nibs, which were manufactured in the usual way, though at first it was not entirely satisfactory for this purpose, as the loss by abrasion was rather great. But by slightly oxidizing the surface the nibs became hardened so that this loss was considerably reduced, though it was still greater than that of ordinary steel pens. Another use of tantalum was that it seemed to be a suitable material for making the knives used by surgeons, if slightly oxidized before polishing. If heated to a dull red it absorbed gases, and in so doing lost its strength and became brittle, a property which somewhat detracted from its usefulness. Its melting point in vacua being about 2300 deg. C., it was suitable for use as electrodes in vacuum tubes, and was, in fact, being extensively employed for this purpose. Turning to its applications as filaments for incandescent lamps, the lecturer showed that the original diameter of the wire used for this purpose had been reduced from 0.05 mm (2 mils) to 0.03 mm (1.2 mil). After the lamp had been used for a short time the strength of the filament decreased, and it also underwent certain structural changes. After about 1000 hours it showed signs of a capillary contraction, as if the filament were going to break into a series of drops. As to the manufacture of the tantalum filament it was stated that the metal is reduced from the ore in the form of a black powder, which is compressed and finally melted in a vacuum into buttons. These buttons consist of pure malleable tantalum, and are rolled and finally drawn into wire. Filaments for about 45,000 lamps are made from 1 kg (2.2 lb.) of tantalum. In conclusion, Mr. Siemens mentioned two interesting properties of the metal, viz., that if heated in a high vacuum any oxygen contained in the metal would be expelled, so that the filaments which were "spotted," owing to the fact that a certain amount of oxide was contained in them, would become uniform after burning for a few minutes at the normal voltage. Tantalum would also act as a rectifier when used in an electrolyte as if it were made of the anode. It then became quickly covered with a film of oxide, which stopped the current.—Lond. *Electrician,* April 30; *Elec. Engineering,* April 29.

Lamps for Heating.—An article in which the author gives the results of tests of "radiator" lamps. He shows that from the radiation point of view, bright lamps are best. Most of the heat energy is thrown off from them in vibrations of high frequency and short wave-length; some of it is visible to human sight, and appears as light. It is frequently supposed that the energy which appears as light is wasted, but that is not the case, since light, while it does not heat the air in passing through it, heats objects in its path. A dull lamp, or a non-luminous radiator, heats the air which is in contact with it, and gets rid of its heat mainly by convection, partly by conduction and only to a slight extent by radiation. The effect of coloring a lamp on the outside is to decrease its radiating and to increase its convective properties, by absorption of the short-length vibrations. Frosting the glass of a lamp by sand blasting has no effect on its properties as a radiator. It does not decrease the transparency of the glass. Radiant heat of all wave lengths can come through frosted glass as well as through clear glass, but it is broken up and diffused in its passage. This causes the lamp to present a softened and more pleasing appearance than a bright filament visible through clear, unshaded glass. The spherical candle-power of a frosted lamp is the same as that of a clear lamp, other things being equal, but the candle-power in any given direction may be increased or decreased according to circumstances. It is important in the design of a radiator oven with lamps to make provision for getting rid of the heat generated immediately around the lamps. This is generally done by the aiding air connection currents around the lamps by means of double backs, or channels, behind the reflectors, by which cool air from the bottom of the radiator may rise, become heated, and then be dispersed into the room from the top of the apparatus.—Lond. *Elec. Review,* May 7.

Electric Welding.—V. D. Green.—A paper read before the Birmingham and District Electric Club. The author describes the Benardos system and the "voltex" system, and then deals at greater length with the process of welding due to Elihu Thomson. With regard to the horse-power necessary for various kinds of work, the following set of figures are given:

ROUND IRON AND STEEL.

Diameter.	Area.	Hp.	Seconds.	Hp seconds.
¼ in.	.05 sq. in.	2	10	20
⅓ in.	.1 sq. in.	4.2	15	63
½ in.	.22 sq. in.	6.5	20	130
⅝ in.	.3 sq. in.	9.0	25	225
¾ in.	.45 sq. in.	13.3	30	399

These figures were taken from actual tests made upon Thomson welders. For extra heavy iron piping, rather more energy was required on account of the greater radiating surface in proportion to the mass.

EXTRA HEAVY IRON PIPING.

Inside diameter.	Area.	Hp.	Seconds.	Hp seconds.
½ in.	.3 sq. in.	8.9	33	293.7
¾ in.	.4 sq. in.	10.5	40	420
1 in.	.6 sq. in.	16.4	47	770.8
1½ in.	1.1 sq. in.	32.3	70	2,261
2 in.	1.65 sq. in.	42	84	3,528
3 in.	3.0 sq. in.	96.2	106	7,197

Generally speaking, iron and steel required less energy than copper, brass coming between them in this respect.—Lond. *Elec. Review,* April 30.

Technical Education in England.—A paper read before the (British) Association of Teachers in Technical Institutions. The author shows that the defects of English technical education are due, not to the lack of money or effort, but to the absence of national organization, resulting in competition between existing colleges. He considers it essential that the Board of Education should establish a national system of technical education.—Lond. *Electrician,* May 7.

BOOK REVIEWS.

High-Tension Underground Electric Cables. By Henry Floy. New York: Electrical Publishing Company. 135 pages, 4 ills. Price, $2.

The manual is arranged as a reference book for engineers interested in the design of underground transmission systems. It contains in condensed form a large amount of information concerning practical experiences with high-tension cables. A valuable feature of the book is a table giving complete data on cables used by 35 different companies in the United States and Canada; these cables vary in length from 1 mile to 340 miles, and are operated at e.m.fs. from 6600 volts to 25,000 volts. Full instructions are given for testing the insulation of cables, while formulas are developed for calculating the capacity of cables from the dimensions of the dielectrics. The concluding chapter of the book deals with the cost of cables, especially as affected by the variation in the e.m.f. The book should prove of much value to engineers contemplating the installation of transmission systems in congested districts.

Development and Electrical Distribution of Water-Power. By Lamar Lyndon. New York: John Wiley & Sons. 317 pages, 158 ills. Price, $3.

This treatise is devoted largely to descriptions of actual installations rather than to a discussion of theory or methods of

design. In addition to the complete descriptions of nine prominent hydro-electric generating and transmitting systems, the book contains discussions of the various details, including dams, canals and flumes, power houses, waterwheels, generators, transformers, transmission conductors, pole lines, lightning-protection and controlling apparatus. Although the theories relating to the hydraulic and electric features are barely touched upon, yet numerous hints are given concerning the selection of certain design proportions in the hydraulic end and the choice of certain machines for the electrical end. The discussions deal largely with actual equipments and the suggestions are based on operating experience. The book contains very few errors, although one error is repeated a great number of times. After explaining properly that "power" is measured in watts, the author continually uses the incorrect terms "energy" when referring to watts and "power" when dealing with kw-hours, kw-years or hp-years. The treatise is of value as a convenient reference book relating to standard practice in hydro-electric transmission installations.

THE HUGHES AND BAUDOT TELEGRAPHS. By Arthur Crotch. London: S. Rentell & Company. 83 pages, 41 ills. Price. 1 shilling and 6 pence.

The writer has presented a very practical description of these two forms of telegraphic type-printer, suitable for the use of telegraph operators and for students of telegraphy generally. The description is clear and enters into constructive detail. The electrical principles of action are subordinated to the mechanical principles. The work may well serve as a guide to the assembling, testing and construction of the Hughes and Baudot instruments.

NAVAL ELECTRICIANS' TEXT-BOOK. (1908.) By Lieut-Comdr. W. H. G. Bullard, U. S. N., Annapolis, Md.; U. S. Naval Institute. 976 pages, 407 ills. Price, $6.50.

While this volume is primarily intended for use as a text-book for midshipmen at the U. S. Naval Academy, its plan is such as to render it useful to anyone desiring to have at hand a comprehensive work containing formal statements of elementary electrical principles, simple and clear descriptions of a large range of present-day electrical apparatus and appliances, together with routine instructions for their operation and care. We assume that the work is complementary to a systematic course of instruction in electrical science and electrical engineering, as its contents relate almost entirely to the descriptive and operative side of the electrical art Otherwise, we fear that one depending upon knowledge gained from it alone will, after graduation, find it difficult to keep abreast of electrical development or even to retain the information of condensed handbook order garnered at school from its pages. On the other hand, as an instructive book for the routine care and operation of the apparatus specifically considered, the book is excellently planned and executed.

HYDRO-ELECTRIC PLANTS. By R. C. Beardsley. New York: McGraw Publishing Company. 512 pages, 480 ills. Price, $5.

This book treats both theory and practice and deals with both the hydraulic and the electric sides of hydro-electric developments. The nine chapters are given the headings: hydraulic principles, measurement of flow, reconnaissance of water-power, materials, hydraulic construction, power-house construction, power-house equipment, power transmissions, and tables and formulas. Somewhat more than half of the book is devoted to hydraulic features, which are treated in an instructive and convincing manner. Much attention is paid to power-house construction and equipment, the descriptive matter dealing more with the building and turbines than with the electrical apparatus. The chapter entitled "Power Transmission" covers gearing, shafting, belting, rope transmission and electrical transmission; it could well have been divided into two parts, dealing respectively with mechanical couplings and electrical transmission systems, the former being treated as a station detail and the latter as a prominent feature of the electric installation.

As will be noted from the above brief outline, the book contains much information relating to hydraulic features. Considerable care has evidently been exercised in rendering the statements accurate. It surprises one, therefore, to find a fundamental error in a hydraulic unit on page 1, where the value of the "miner's inch" is given in gallons without specifying the time. The book as a whole is well written. The arrangement makes it particularly suitable for the use of the engineer who is familiar with electrical apparatus and wishes guidance in the design or selection of hydraulic details or equipment.

TRANSIENT ELECTRIC PHENOMENA AND OSCILLATIONS. By Dr. C. P. Steinmetz. New York: McGraw Publishing Company. 556 pages, 102 ills. Price, $5.

Few indeed are the writers who can discuss with any degree of authority the subject selected by Dr. Steinmetz for his latest contribution to electrical engineering literature. The debt of the profession to the author for his present work is, therefore, even greater than that for his earlier books. The former contributions dealt largely with relatively familiar subjects, which, however, were treated in an original and most thorough manner, while the present book covers instructively a subject that has usually been avoided by writers on electrical engineering topics.

The book is divided into four sections, dealing, respectively, with transient phenomena in time, in space, in both time and space, and with periodic transient phenomena. Under the first head fall the building up of the magnetism in a direct-current generator, the charging of a condenser, the storage of energy in a magnetic field, the surging of energy between magnetic and electrostatic fields, short-circuiting of alternators, etc. Transient phenomena in space exist in long-distance transmission lines and in high-frequency conductors, used in aerial communications. The section on transient phenomena in both time and space deals with stationary waves in underground and overhead transmission systems and in telegraph circuits; with traveling waves and free oscillations in electric circuits; transition points and energy in complex circuits, and inductive discharges from transmission lines. Periodic transient phenomena are those encountered in current rectifiers and voltage regulators.

The book may be said to deal largely with those phenomena which are usually neglected in designing transmission systems of moderate length, but which should not be ignored in interconnected systems of great length comprising high-voltage overhead circuits and medium-voltage underground cables. In addition, it deals with phenomena of more frequent occurrence, which are treated, however, in most cases, more exhaustively than has been done hitherto. The treatment throughout the whole book represents work of a pioneer nature, either with reference to the phenomena discussed or concerning the method of attack or skill in presentation. The physical relations discussed are much more complex than those covered by the author's well-known book, "Alternating-Current Phenomena," but the reviewer ventures the assertion that the average reader will be able to follow the demonstrations with less difficulty than encountered with the earlier book, largely because in the present treatise the author has expressed the inter-relations in the familiar languages of the algebra, the trigonometry and the calculus rather than in "symbolic equations," which are as a foreign language to most readers. The treatment dealing, as it does, with highly complex inter-related phenomena is necessarily mathematical, but the author has made a surprisingly limited use of calculus. Moreover, the equations employed are fully translated into statements of the physical relations, and little doubt can exist in the mind of the reader as to their significance.

Beyond any doubt the book represents the author's masterpiece. It will be the standard treatise on the subject of transient electrical phenomena for many years to come, and historically will always occupy a high place in electrical literature.

NEW APPARATUS AND APPLIANCES

Frink Reflectors.

By W. H. Spencer.

As far back as 50 years ago, when nobody even dreamed of illuminating engineering, when the oil lamp was the most commonly used illuminant and gas lighting was in its infancy—at such an early stage of the art of illumination, Frink reflectors

FIG. 1.—SHOWROOM REFLECTOR.

were in extensive use. As a consequence of the gradual accumulation of experience in this long period, it was entirely possible to secure satisfactory results in design in the absence of systematic engineering data or methods, which have only recently been formulated. Such empirical design is, however, apt to fail if the proper engineering intuition is lacking, but with

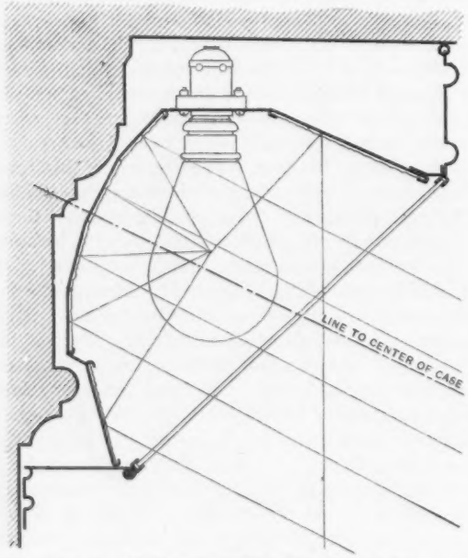


FIG. 2.—DESIGN OF SHOWROOM REFLECTOR.

this present, the principles actually involved in designs found successful in use will, as a rule, eventually be capable of verification on theoretical grounds when these latter are established. This has held true in the case of Frink reflectors, which, in fact, have in the past represented correct illuminating engineering as understood to-day, for in addition to serving satisfactorily the purposes for which they were specified, they prove to be correct in principle when checked by up-to-date mathematical calculation. Nowadays the use of quick mathematical calculation greatly facilitates reflector design, and that method is bound to

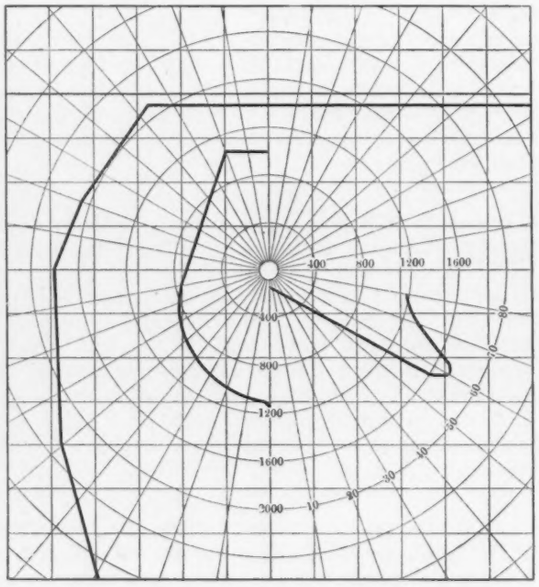


FIG. 3.—THEORETICAL REFLECTOR DESIGN.

be of still higher value when united with experience gained in long practice in the art.

An interesting example may be cited showing the relation between correct theory and successful practice. A showroom 30 ft. x 30 ft., and especially the showcases near the walls, were to be illuminated. A pillar was located exactly in the center of

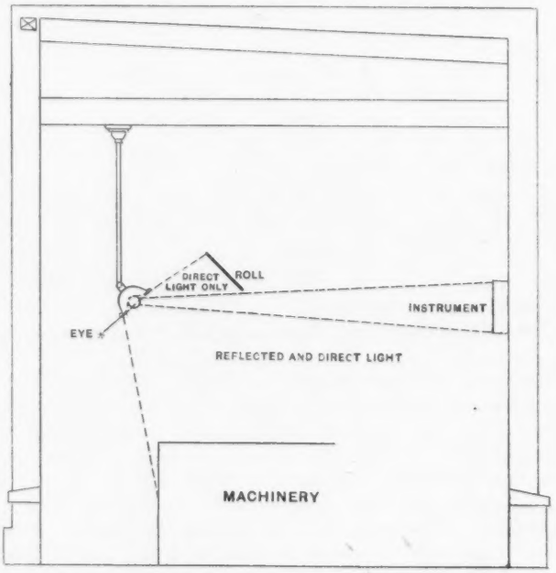


FIG. 4.—REFLECTOR FOR RAILROAD SIGNAL TOWER.

the showroom and surrounded by a settee, and the specifications were drawn up for the illumination of the showroom and showcases from a fixture surrounding the capital of the pillar, as shown in Fig. 1. The illumination of the counters was fixed at 2 candle-ft., and on the showcases at 3 candle-ft. Fig. 2

shows the design of the Frink reflector for accomplishing the desired result. The greater part of the light in parallel beams is directed (at 65 deg. from the vertical) toward the center of

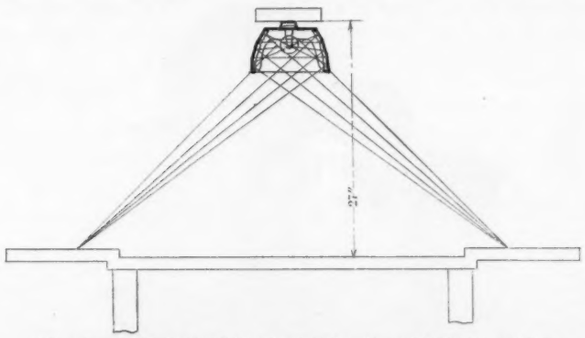


FIG. 5.—CONCENTRATING REFLECTOR FOR WORKING TABLES.

FIG. 6.—BANK SCREEN AND DOUBLE-DESK REFLECTORS.

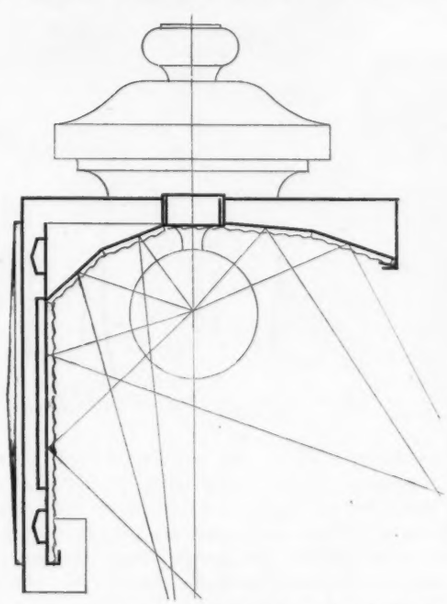


FIG. 7.—DESIGN OF SPECIAL REFLECTOR FOR LIGHTING WALL CASES AND COUNTER CASES.

the showcases, leaving one panel and the direct light of the lamps for the illumination of the counters. A polar curve, Fig. 3, was then laid down for the fixture as a whole, which shows that by far the larger part of the light is directed at angles from 50 deg. to 70 deg., that a considerable amount of light is directed at angles from 70 deg. to 80 deg., and a somewhat smaller part at angles from 50 deg. to 60 deg., while the direct light of the lamps is almost sufficient for the horizontal illumination of 2 ft.-candles on the plane at angles from 0 deg. to 50 deg. In

FIG. 8.—STORE REFLECTOR.

practice the design thus, in fact, departed from exactness by an amount so small as to be scarcely recognizable to the naked eye, though evident by photometric measurements.

An advantage of the Frink system of illumination of great interest to the illuminating engineer consists in the possibility of screening the eye of the observer from the direct light and glare of the lamps and at the same time utilizing this otherwise harmful light for useful illumination. An example of this is illustrated in Fig. 4, which shows a reflector used for special illumination in the signal towers of railroads. The same lighting unit illuminates the indicator, special machinery, instruments, etc., while no light strikes the eye of the operator nor of an engineer coming in out of the darkness. Still another example is illustrated in Fig. 5, which shows a reflector designed to con-

FIG. 9.—ART-GALLERY REFLECTOR, LOTUS CLUB, NEW YORK.

centrate the light upon a working table—for instance, on the needle points of sewing machines and the like—while at the same time concealing the lamps from the eyes of the operator.

Not only concentration of light, but also uniform illumination can be readily and effectively obtained by Frink reflectors. For

instance, a reflector of similar appearance to that illustrated in Fig. 5, but designed to illuminate uniformly the working plane, can be used with great advantage for double bookkeeper desks and drafting tables, or when cut in half and properly modified it can be applied over bank windows, flat-top and single bookkeeper desks. Such a reflector is shown in Fig. 6, representing an installation which has met with much satisfaction as the eyes are shielded from the glare of the lamp, while a uniform illumination is provided for the working plane.

All the above effects are combined in a reflector of a design shown in Fig. 7. This reflector is designed to illuminate showcases and counters with an equally uniform illumination, avoiding, however, any glare proceeding directly from the lamps or reflected from mirrors or other glassware. An actual installation of this reflector is shown in Fig. 8, which gives a fair idea of the artistic effect which can be obtained by this class of design. Fig. 9 shows the effect of a Frink art-gallery reflector, properly designed and properly placed. The result is an evenly diffused light over the entire picture space, without glare in the pictures or shadows caused by heavy frames.

Electrically Operated Household Utensils.

By means of a single motor and flexible shaft the A. A. Automatic Manufacturing Company, of New York City, has adapted a great many kitchen and household utensils to electric drive. The "automatic kitchens," as they are termed, are made

FIG. 1.—ELECTRICALLY OPERATED HOUSEHOLD UTENSILS.

in three styles. The first style is primarily intended for use in small apartments where space is limited. By means of a flexible shaft a potato-peeler, coffee-grinder, dough-mixer, butter-churner, egg and cream beater, fruit-juice extractor, ice-cream freezer, meat and food chopper, washing-machine, vacuum cleaner, etc., may be operated from the motor. The second style has an advantage over the first style in that either one or two utensils may be operated at the same time, the machine being provided with two flexible shafts, one operating at slow speed and the other at a higher speed. The third style possesses the advantage that all the utensils are clamped to a revolving-table top in proper position. When a change from one utensil to another is desired, the table top is revolved until the utensil desired is brought opposite the flexible arm of the motor. In addition the manufacturer is bringing out a large machine for hotel and restaurant use, having as many flexible

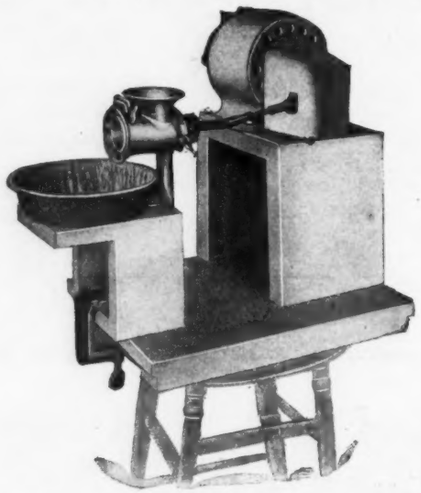
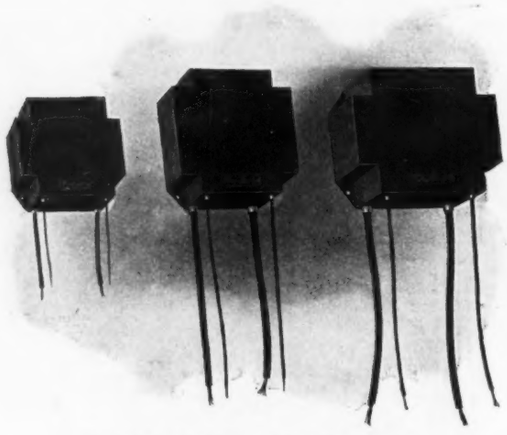


FIG. 2.—ELECTRICALLY OPERATED CHOPPER.

shafts as there are utensils to be operated. Two of the outfits are illustrated herewith.

Tungsten Sign-Lamp Transformer.

The Packard Electric Company, of Warren, Ohio, has designed and placed on the market a line of special transformers to meet the new conditions of sign-lamp service, with the tungsten low-voltage lamp. The transformers are neat in appearance, compact and as light in weight as is consistent with good economy. They can be attached to the sign itself, which eliminates the voltage drop in the low-voltage leads. The trans-



TUNGSTEN SIGN-LAMP TRANSFORMERS.

formers are designed to give an exact ratio of 10 to 1 under full-load conditions, and are controlled through the primary circuit so that when the sign is not illuminated the transformer loss is eliminated. The transformers are not made on the auto-transformer principle, but are designed with separate primary and secondary coils amply insulated from each other. The vacuum drying and impregnating system of insulating is used as with the company's standard transformers. The case is made of leaded sheet iron the better to withstand weather conditions, and is filled with solid compound of high heat conductivity, insuring reasonable temperature limits. Moreover, it is sealed in place to exclude moisture. All of the leads are carried out through porcelain bushings, each carefully sealed in.

Heavy Wire Terminations.

BY ANTHONY GORHAM.

Broadly considered, the material and labor involved in the installation of a large open-work conductor may be divided into two general items, that necessary for supporting the conductor between termination points or "dead ends," and that necessary for terminating or "dead ending" the conductor. The installation of runs between termination points, as a rule, presents no difficulties. Insulating supports, which can be readily

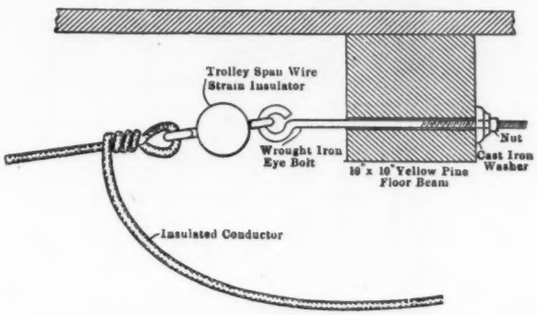


FIG. 1.—AN UNECONOMICAL METHOD OF TERMINATION.

and ruggedly mounted, are commercially obtainable in many convenient types. These, spaced frequently, serve to support the conductor against lateral displacement, and to insulate it from adjacent materials.

Almost invariably the work of terminating a large open-work conductor is the most exacting, and frequently the most expensive unless expedient methods are used, involved in its installation. It should be added that the word "termination," as used here does not necessarily imply the actual termination of the conductor. Where the direction of a feeder run is changed (as shown, for instance, in Fig. 5) it is necessary that the conductor be "dead-ended," at the end of each run, to a strain sustaining appliance. The same construction is involved at a "dead-ending" whether the run is actually terminated or whether its direction is changed, so the word "termination" as used in this article may imply either condition.

In modern industrial-plant practice it has been found best to depend entirely on the terminal supports for sustaining the longitudinal tension in the conductor and to incorporate with such supports appliances for tightening it, for mechanically connecting it with the tightening device and for insulating it therefrom. Obviously a vital requirement of any method of termination is that it shall be capable of sustaining a tensile stress great enough to keep the conductor it holds taut. Because of this requirement the only practicable methods involve the use of strain insulators of one type or other, which serve to transmit the tension in the conductor to some stationary support and at the same time to insulate the conductor from that support. For tightening, some form of bolt or turnbuckle is used.

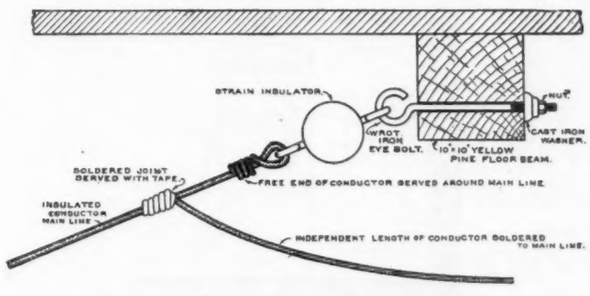

STRAIN INSULATOR
NUT
WROT. IRON EYE BOLT.
CAST IRON WASHER.
10"x10" YELLOW PINE FLOOR BEAM.
SOLDERED JOINT SERVED WITH TAPE.
FREE END OF CONDUCTOR SERVED AROUND MAIN LINE.
INSULATED CONDUCTOR MAIN LINE.
INDEPENDENT LENGTH OF CONDUCTOR SOLDERED TO MAIN LINE.

FIG. 2.—ANOTHER UNECONOMICAL METHOD.

From the standpoint of good construction, there appear to be but three feasible methods of making a heavy wire fast at its termination: (1) By carrying the wire (as shown in Fig. 1) without cutting it, through the eye of a strain insulator and serving the bight around the main line. (2) By cutting the wire, carrying the end through the strain insulator eye and then serving this free end around the main line, as shown in Fig. 2. (3) By using a cable clamp and a strain insulator as shown in all of the other drawings.

Obviously the first method (Fig. 1) can be advantageously applied only in the case of comparatively small conductors. With the exercise of much muscle, judgment and good workmanship it is possible that it might be utilized in emergency cases where conductors as large as, say, 300,000 circ. mils, and even a little larger, are involved. The process, however, of bending the bight of a conductor of large size into a spiral-shaped serving around the main line, is a time-consuming, and, therefore, an expensive one. This is particularly true where two adjacent terminations are necessary (as shown in Fig. 5) in the same conductor, because of a change in direction, or if the termination has to be made high above the ground from a staging or in a confined space. To sum up the status of this method it may be said that it is impossible to use it for very heavy wires and is not to be recommended, because of the labor cost involved, for any except small wires, say, those smaller than No. 0.

In the method shown in Fig. 2 there is no limit to the size of the conductor that can be handled, inasmuch as a length, at the end of the conductor, can be "skinned" and the strands composing it unwrapped. Each strand can be carried through the strain insulator eye, one at a time, and served around the skinned portion of the main line. The served ends should then be soldered to the main line, to hold them in position and to prevent the joint failing upon the application of a tensile stress. Then an independent length of conductor must be served around and soldered to the main line as indicated. This independent length may convey electricity to the adjacent conductor (if the termination is made to permit of a change in direction of the run) or to a nearby energy consuming device. Here again the expensive item, labor, is an important factor. Unstranding the conductor ends, serving them around the main line and soldering them is slow, expensive work and if neatly done requires considerable skill. Furthermore, it is almost always necessary to cut off waste ends which are usually too short to have any other than a junk value. It appears, then, that while this method is feasible for all sizes of conductors, it is expensive and should not be used if a less costly method is available.

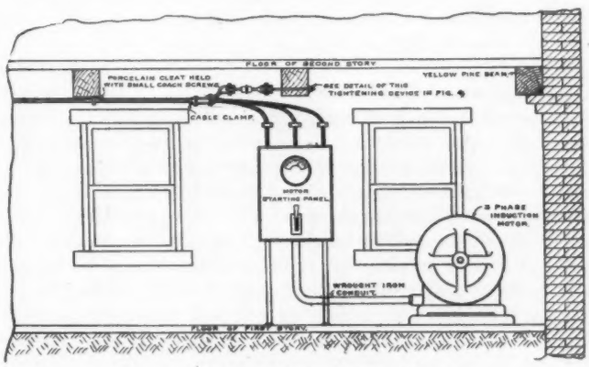

FLOOR OF SECOND STORY.
YELLOW PINE BEAM.
PORCELAIN CLEAT HELD WITH SMALL COACH SCREWS.
SEE DETAIL OF THIS TIGHTENING DEVICE IN FIG. 4.
CABLE CLAMP.
MOTOR STARTING PANEL.
3 PHASE INDUCTION MOTOR.
WROUGHT IRON CONDUIT.
FLOOR OF FIRST STORY.

FIG. 3.—TERMINATING MOTOR FEEDERS.

In the other method (shown in all illustrations except Figs. 1 and 2) it is only necessary to bolt a cable clamp to the conductor, a section 4½ in. long having been "skinned" for its reception, and to fasten the clevis of the cable clamp to the eye of a strain insulator. These operations require no skill and take but little time. The result is a neat, quickly completed sturdy job. The conclusion is, therefore, that the method is the neatest and the most economical of all, if the cost of a cable clamp is less than the cost of extra labor and waste ends inherent to both the other methods. It will be found that in practically all cases the cost of the cable clamp will be less.

Absolute comparisons in dollars and cents have purposely

been avoided in the above discussion of the relative merits of the three methods. This is because that, even if several examples were tabulated, definite labor rates, a specific number of men required to do the work and a certain cost of conductor would have to be taken while they would be accurate for one plant in one section of the country, they would not apply absolutely to another plant in another section with a different grade of labor. Such variances might cause misunderstandings. It is believed that the truth of the conclusion, that the

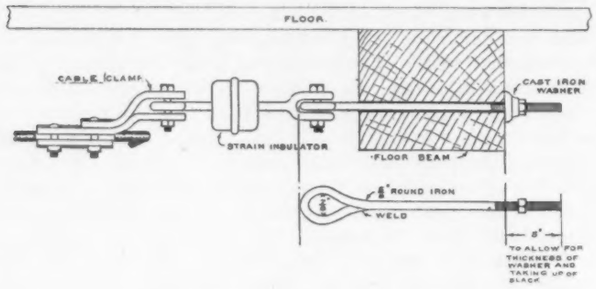


FIG. 4.—DETAIL OF EYE BOLT IN FIG. 3.

clamp method is best and cheapest, will, after what has been outlined, be conceded by all who have handled much heavy wire. If one doubts, he should terminate one end of a certain run by either of the first two methods and use the clamp method at the other, keeping costs in each case.

Descriptions of some examples of terminations representative of good practice follow. In each, because of its general superiority, the method in which a cable clamp is used to hold the conductor is utilized.

Fig. 3 illustrates an excellent method of terminating wires conveying electricity to a large motor or other electrical appliance installed in a building of brick and wood "mill" construction. Enlarged details of the terminating appliances used in Fig. 3 are shown in Fig. 4. The cable clamp is held on the conductor by four ½-in. bolts. A short section of the conductor is bared for its reception. The clamp provides a means for attaching the balance of the "dead-ending" equipment. The cable clamp is a patented contrivance and may be secured through any dealer in electrical supplies. The strain insulator shown, provided with an eye at one end and a clevis at the other, is also a commercial article. Its function is to transmit the pull in the conductor to the adjacent eye bolt at the same

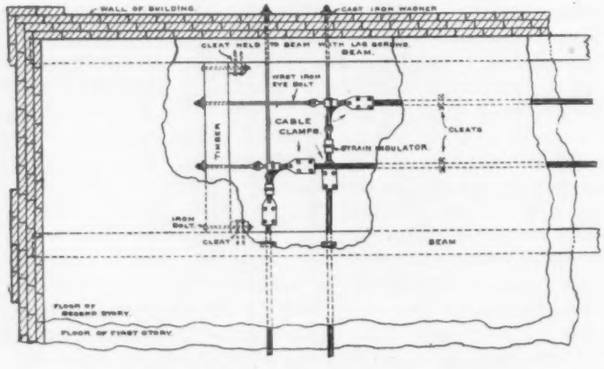


FIG. 5.—RIGHT-ANGLE TURN IN HEAVY WIRES.

time insulating one from the other. The eye bolt can be readily formed, from ⅝-in. round wrought iron, by any blacksmith.

Referring again to Fig. 3, it is assumed that at the other end of each of the wires therein shown there is a terminal arrangement the same as shown in that figure. In erecting the job (Fig. 3) the conductors should first be strung through or raised up into the porcelain cleats, which should be sufficiently loose about the conductor so as not to grip it. The conductor being in place in the cleats, a cable clamp is bolted to it at one end (which will be denominated end No. 1), a strain insulator bolted into this clamp, the eye bolt inserted in the hole through the beam and the washer and nut run on the eye bolt. The nut should be on only far enough to insure all of its threads engaging with the bolt threads. End No. 1 having thus been temporarily made fast, the wire should be drawn taut from the other end, which will be designated as end No. 2. Accordingly another clamp is bolted, at the correct location, on the conductor at end No. 2. A sling, from a set of tackle blocks, is made

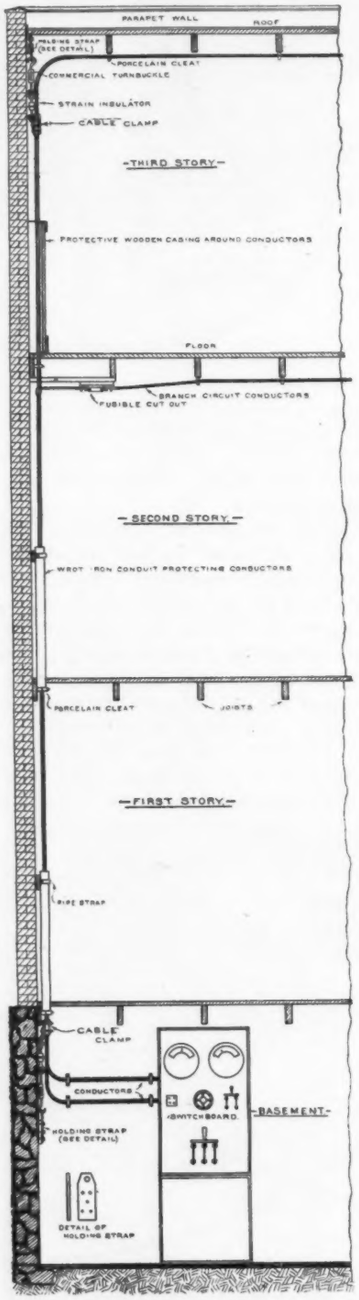


FIG. 6.—FOUR-STORY VERTICAL RUN.

fast around the conductor just forward of the clamp, which prevents the sling from slipping. The line from the tackle blocks is pulled upon and the greater part of the slack drawn from the conductor. If the point of application of the clamp at this end, No. 2, was well chosen, it should now be possible to engage the eye of the strain insulator (it having already been bolted to the eye bolt, which, with nut and washer on, rests ready in the hole in the beam) with the clevis of the cable clamp and to insert the bolt that holds them together. This

having been done, the conductor can be stretched as tightly as need be by turning the nuts on the eye bolts at ends Nos. 1 and 2. The job is completed by tightening the lag screws holding the porcelain cleats. The cable clamp and the "alive" metal portion of the strain insulator should be, in this and in all cases, served with insulating tape to meet National Electrical Code requirements.

In Fig. 5 a plan view of a second-story corner of a mill building, with a section of the floor broken away, is shown. It

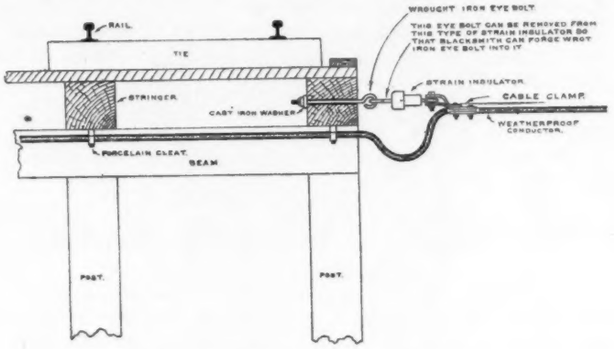


FIG. 7.—TERMINATION AT A TRESTLE.

indicates a substantial arrangement for making a right-angle turn in a two-wire feeder, carried on the ceiling and on the lower face of the floorbeams. Cable clamps, strain insulators and eye bolts are used in much the same manner as described in connection with Fig. 3, and the description given in connection with that illustration applies here. Four terminating appliances are necessarily used in this case because strains in two directions must be provided for. It is profitable to consider the complication and labor that this job would have involved had the terminations been made without using cable clamps.

It is frequently necessary to install a heavy vertical feeder or "riser," several stories in length, to distribute energy for motors or lighting appliances installed on several stories of a structure. In Fig. 6 an excellent example of an installation of this character is delineated. Turnbuckles are availed of to tighten the conductor. These are threaded right-hand at one end and left-hand at the other, and may be purchased through any hardware concern. They are regularly manufactured in a variety of wrought-iron rod sizes and can be furnished with either eye bolt or hook bolt at either or both ends. The holding strap, detailed in the lower left-hand corner of the illustration, is cut from wrought-iron or mild-steel plate and the holes

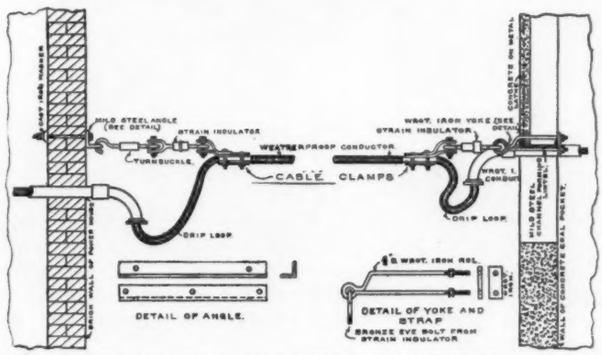


FIG. 8.—TWO TERMINATIONS ON SAME FEEDER.

are drilled or punched through it. It is essential that this holding strap be substantially secured to its support. In the illustration it is shown held with lag screws to a wooden cleat, but in a steel-framed building it would be bolted to some steel member.

Fig. 7 illustrates a dead end, at a wooden trestle such as frequently must be made in a feeder to an electric locomotive trolley wire or third-rail. The only unusual feature of this application is the strain insulator, which has an eye at each end, instead of an eye at one end and a clevis at the other, as those previously referred to have had. One of these eyes can be removed, by unscrewing, to enable the blacksmith to forge and weld the eye of a wrought-iron eye bolt into it. This procedure is impracticable with the ordinary type of strain insulator because of the low melting point and inflammability of the insulating material used in strain-insulator construction. This type of insulator is designed to withstand the severest

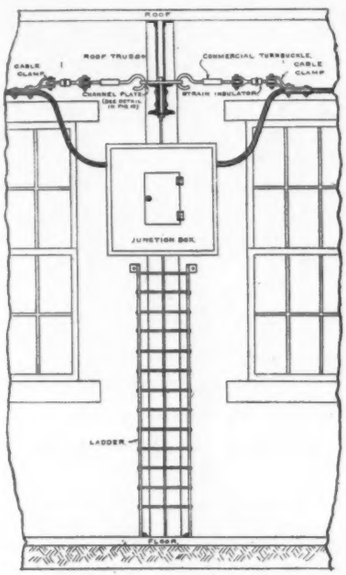


FIG. 9.—DEAD-ENDS AT A JUNCTION BOX.

strains and is of considerably more rugged construction than the ordinary. All of its metal parts, with the exception of the insulated bolt, are of bronze.

The two out-of-door terminations shown in Fig. 8 are at opposite ends of the same run. The conductor shown carries electricity from a brick generating station to a coal-handling crane in a reinforced-concrete coal pocket. It being a three-phase installation, three wires are necessary. A mild-steel angle, which is detailed in Fig. 8, bolted to the brick wall of the power house, provides means for attachment at that end and a special type of U-bolt or yoke, also shown in detail, made by the plant blacksmith, furnishes means at the other. It is to be noted that the eye in the U-bolt is forged around the removable eye of the strain insulator, which is of the heavy type referred to in connection with Fig. 7. This particular run is of No. 00 stranded wire and is 195 ft. from building to building. There are no intermediate supports, the stress being

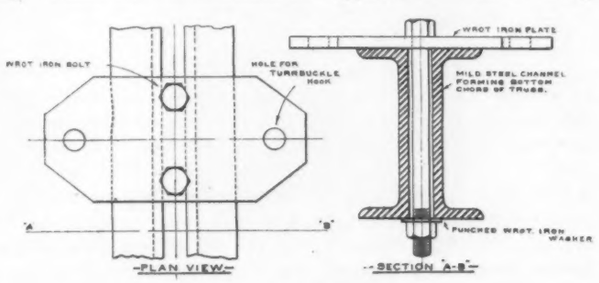


FIG. 10.—DETAIL OF CHANNEL PLATE.

wholly taken by the terminal cable clamps, strain insulators and bolts.

Mains feeding into a sheet-steel junction box are shown in Fig. 9. The junction box is attached to a steel column just under the bottom chord of the roof truss. Each of the conductors is supported, in its run down the building, on large porcelain cleats carried on the top of the channels constituting the roof-truss bottom chords. The scheme used to provide attachment for the turnbuckle hooks is shown in Fig. 10.

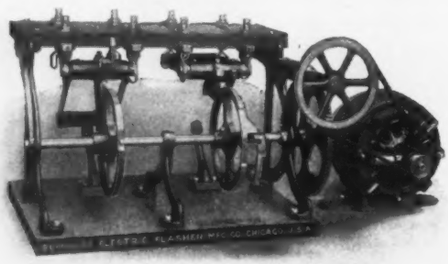
Tungsten Sign Lamp.

The General Electric Company is placing on the market a tungsten sign lamp in voltages of 8, 10 and 12, consuming 5 watts and rated at 4 cp. The new lamp can be operated on alternating-current circuits in multiple on special sign transformers for reducing the ordinary 100-130 volts to tungsten sign-lamp voltages. As sign lamps generally operate in banks and burn continuously, the transformer is carrying full load or none at all and can be cut off when the sign is not in use. The sign transformer can therefore be operated at a very high efficiency. The lamps may also be used in series on circuits of standard voltages. Lamps selected for uniform amperes are supplied for this service when it is made known that lamps ordered are intended for series operation.

The lamp has a very sturdy V-shaped filament well supported by an anchor, will burn in any position, and it is estimated will give an average life of 2000 hours. This is the significant point in regard to this lamp because the saving of 15 watts per lamp, due to the use of tungsten instead of carbon, will, during the life of the lamp, result in a saving of 30 kw-hours for each lamp. As the net cost to central stations of the tungsten over the carbon lamp is only from 20 cents to 25 cents, this will readily be seen to involve a substantial net saving per lamp.

Electric Sign Flasher.

The Reynolds Electric Flasher Manufacturing Company, of Chicago, has brought out a new flasher for electric signs and electrical designs, which in its mechanical and electrical features is an improvement on the previous types made by this company. A view of this flasher as built for two 20-amp circuits is shown below. Each of the double-pole switches seen on the flasher is rated at 20 amp, at 110 volts, although as regards size and strength they are about equivalent to a 50-amp hand-operated switch. These switches have the self-lubricating jaws which have been a feature of "Reco" flashers for some time. The jaws are U-shaped, being turned back in such a way as to form a pocket for grease, which is fed to the contact surface through a slot in the switch jaw; when once lubricated in this way, the flasher will operate a long time without additional lubrication, while at the same time the life of the switch is prolonged and oxidizing of the blades and jaws avoided. The switch jaws are made of ½-in. x 3/64-in. copper, and the blades are 5/8-in. x 1/8-in. copper. The top and bottom slabs of the flasher are of slate. Switches for controlling larger circuits are constructed of proportionately heavier copper.



ELECTRIC SIGN FLASHER.

An important feature of the flasher is the provision made to prevent the various parts from working loose, as a flasher must operate continuously for long periods without attention. The switch terminals and binding posts in the upper slab of slate have rectangular channels milled in the slate, into which the terminals fit closely, so that they cannot turn and work loose. There are also channels milled out to receive the iron frame which supports this top slab. These channels, however, are only in the corners and do not extend clear across the end of the slab so as to weaken it. The bearings are made by boring holes directly in the iron standard, as the speed of the shaft is very slow and the complication of special journal boxes not desirable. The worm and gears are machine cut.

The opening and closing of the switches is accomplished by a new form of mechanism. An iron dog attached to a hard-fiber switch axis engages a case-hardened tooth on the wheel which operates the switch. The tripping of the mechanism is accomplished with this tooth. The wheel carries a sector which engages with the dog and causes the switch to open instantaneously, thus avoiding undue arcing.

The new "Reco" will produce any desired effect, from flashing whole signs to flashing hundreds of lamps one at a time. It is built with both single- and double-pole switches. The single-pole switch operates by flashing up one word, one letter or one lamp at a time. The double-pole switches are for flashing up whole signs, double-face signs, whole words or any number of lights at one time.

New Type of Pittsburgh Transformer.

In developing the new type of transformer shown in the accompanying illustrations, the Pittsburgh Transformer Company has adhered to its well known core-type design which has been altered in its relative proportions in order to utilize to the fullest extent the great advantages of the alloy steel used in the cores of the new transformer. In its mechanical design this transformer is claimed to possess a number of exclusive features, as well as important improvement along lines which have come to be regarded as standard by transformer users. Experience has indicated that a large proportion of transformer troubles is due solely to mechanical construction, which, although good, still leaves much to be desired, and as a result the purpose has been to produce a transformer distinguished by a ruggedness heretofore unapproached in the manufacture of small transformers.

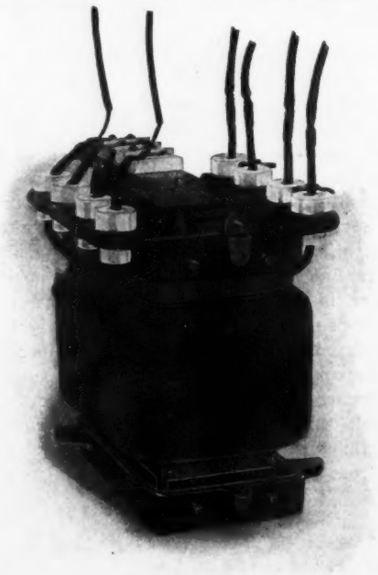


FIG. I.—VIEW OF TRANSFORMER, SHOWING PORCELAIN BUSHINGS.

The porcelain bushings through which pass the primary and secondary leads, are extremely large, for example, the bushing used in the 3-kw size weighs 12 oz., whereas it is common practice to use, in such small transformers, a bushing weighing slightly less than 1 oz. The most obvious advantage of the large bushings is that breakage is practically impossible and this at once does away with grounded primary lines due to broken bushings. Other advantages are that on account of the great size of the bushings, very high insulation strength is secured, which reduces the chances of trouble from lightning or static discharges. The effects of wet weather, accompanied by heavy leakage to

ground and burning off of primary leads, are obviated, as the leakage surface of the large bushings is so great that ample insulation is maintained under the most adverse conditions. To accommodate porcelain of such size the new cases are designed with bushing pockets or receptacles of correspondingly increased proportions, and are arranged so that the bushings issue from the case at an angle of 30 deg. The bushing, therefore, slants away from the cast-iron case both inside and outside, and this enables great "jumping" distances to be provided as a

FIG. 2.—TRANSFORMER COMPLETE.

protection against abnormal rise in potential. A further advantage of bushings set on an angle is that this prevents the leads being drawn up against the case, either on the inside or outside, by inexperienced or careless linemen, or from accidental causes. The new bushings are heavily coated with the best glaze, and have all edges rounded to prevent cutting or chafing the leads.

Paper-insulated flexible leads are used exclusively, as it has been found that the usual rubber insulation is not suited for use in oil transformers on account of the fact that it rapidly deteriorates under the action of oil, whereas oil materially improves the insulating qualities of the paper insulation used upon these cables. The transformer, therefore, is not subject to troubles which so frequently occur on account of failure of the insulation at or near the point where the lead passes through the transformer case.

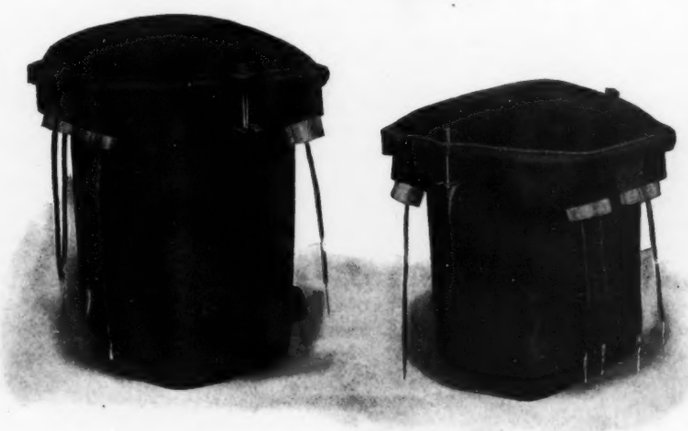


FIG. 3.—TWO SIZES OF TRANSFORMERS.

The transformer is held between cast-iron top and bottom plates and is firmly centered therein by means of set screws. The bottom plate engages the sides of the case, and the top plate also fits the case closely, but to insure absolute rigidity set screws in the top plate are tightened up against the case so as to take up all play. Bolts passing through the top plate engage drilled lugs on the transformer case and hold the transformer in place. The new case is thus designed to secure solidity and strength to an unusual degree, so that rough handling will not cause movement or shifting of the parts to the damage of the coils or leads.

There are eight heavy porcelain bushings babbitted into place on the top plate. The four secondary leads and the four primary leads pass through these bushings and are cemented into them. By this means the leads are held firmly in position so that they cannot move or shift and cause short-circuit. Immediately after leaving the coils the leads pass into these bushings, from which they pass through the heavy porcelain bushings cemented into place in the case. This substantial construction gives the transformer great insulation strength and eliminates the danger of accidental grounding of the leads which might cause burn-out of the transformer or shock to persons making contact with lamp sockets, switches or appliances. The new cases have been designed with unusually large space around the coils, leads, terminal block and cables. As a result the transformer shows increased insulation strength, and as there is more oil surrounding the transformer cooler operation is obtained. The cover is arched from the edge of the case, which thus gives increased clearance directly over the leads where clearance is of great importance. Ample clearance between the cover and the porcelain terminal block is also thereby secured. This construction strengthens the cover greatly. The cover is provided with a storm lip of unusual depth so that driving rain, snow or dust cannot enter the transformer. A felt gasket, 1 in. wide, is seated in a deep groove on the underside of the cover and is compressed between the cover and the edge of the case which affords further protection against the weather.

The outline of the cover has no sharp corners, but it smoothly curved, so that this gasket is properly cemented in place and held securely in position at all points. The bolts which fasten the cover in place pass through lugs on the cover entirely out-

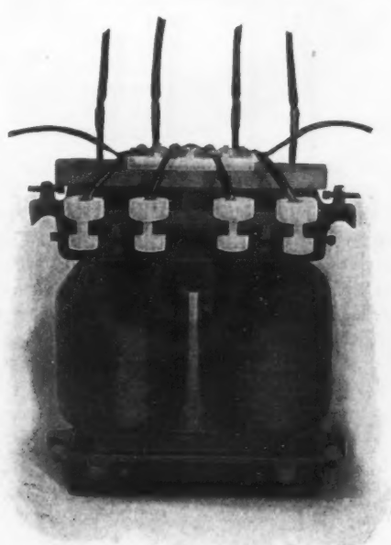


FIG. 4.—VIEW OF TRANSFORMER CASES, SHOWING MEANS OF SUPPORT AND CENTERING IN CASE.

side of the storm lip, which is an improvement over the common practice of drilling such bolt holes inside of the storm lip, whereby moisture is liable to drain from the cover into the transformer.

The new Pittsburgh transformer, although unusually massive in its proportions, is, as will be seen from the illustrations, of graceful design and presents a sightly appearance when installed.

Leaf-Unit Electric Flatiron.

The General Electric Company has lately brought out a new flatiron, the heating unit of which is new both in material, construction and shape. The resistance metal used is named by its patentees "Calorite" and is claimed to be capable of withstanding oxidation to a point several hundred degrees hotter than any metal previously used in heating devices, its melting point being 2370 deg. Fahr. The resistance of "Calorite" is twice that of nickel-silver and 73 times that of copper and it is this high specific resistance which enables it to be used in a single thin grid-layer or leaf. In the majority of designs, the heat must

FIG. 1.—COMPLETE IRON.

either pass through two or more layers of heat insulation or radiate through an insulating air space. The "Calorite" leaf unit has such close thermal relation to the working surface of the iron that it cannot overheat. This construction obviously precludes the use of any auxiliary protective device to insure the life of the heating unit.

In the new iron the heat is evenly distributed over the entire

FIG. 2.—CALORITE HEATING UNIT.

working surface. A "scorch" proof is stated to show that this is practically as well as theoretically true. The toe, the heel and both sides are heated equally, providing for efficient ironing in any direction. The construction of the iron is very simple and rugged. The body is of two hard gray steel cast-iron plates held together by two heavy steel bolts. The thin leaf unit is firmly clamped between these plates and separated from them

FIG. 3.—BASE OF IRON.

only by a sheet of clear amber mica 2/1000 in. thick, which provides the necessary insulation.

The shell cover, held by one bolt, carries a well-made handle riveted to it, a continuous air jacket being formed between this shell cover and the working part of the iron. This insulating air jacket not only covers the top of the iron, but the sides and ends as well, and the use of the objectionable asbestos is eliminated.

The attachments are made of unbreakable material, the use of porcelain being entirely avoided. The leaf-unit flatiron will be equipped with a plain attaching plug, with combination-indicating switch plug or with permanently attached cord, if desired. The few parts of the new iron are readily interchangeable and the iron can be completely disassembled by removing three bolts. The leaf-unit iron is available in the 5-lb. or 450-watt size, and the 6-lb. or 550-watt size. The iron is finished in highly polished nickel.

Porcelain Sign Receptacles.

The Marshall Electric Company, Hyde Park, Mass., has placed on the market a complete line of sign receptacles which are claimed to be a considerable improvement over receptacles

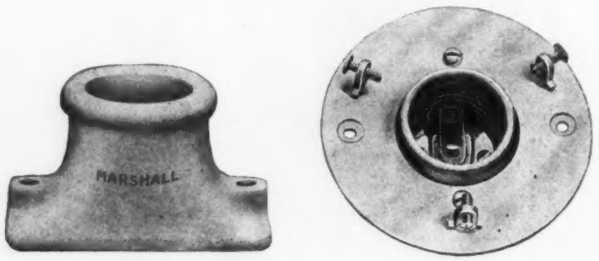
FIG. 1.—RECEPTACLE FOR METAL SIGNS.

heretofore in use for sign work. In general exterior appearance they are very similar to ordinary sign receptacles, but these latter have frequently failed when exposed to the weather owing to corrosion of the shells. To obviate this defect the present sign receptacles are provided with copper screw shells; moreover, the center contact is an elastic spring and is well separated from the other parts by a mica washer. Fig. 1 is a receptacle for metal signs where the wires are sealed in the back, while Fig. 2

FIGS. 2 AND 3.—RECEPTACLES FOR METAL SIGNS.

is of use where no sealing of wires is required. Fig. 3 is designed for use on wooden sign boards.

The same company has also just brought out a new line of



FIGS. 4 AND 5.—PIPE END RECEPTACLES.

molding and pipe-end receptacles, shown in Figs. 4 and 5. The former are similar in exterior design to receptacles heretofore on the market, but with the socket made much stronger, being built into a heavy outer porcelain instead of on a frail base block. The device is very quickly wired. The pipe-end receptacle is shown in Fig. 5. The conductors pass straight through without cutting and are quickly inserted and connected to the binding screws. No pulling or twisting of the wires is necessary. The receptacle also includes a 2¼-in. shade-holder.

"Venus" Small Arc Lamp.

A small arc lamp, about 18 in. long, has been brought out by the American Automatic Manufacturing Company, 105-109 Madison Street, Chicago, and is illustrated herewith. The lamp is attractive in appearance, and by reason of its diminutive size it is adapted for many classes of indoor work. It is said that the actual candle-power of this lamp is 517, with a consumption of electrical energy of 350 watts. The light is

SMALL ARC LAMP.

white and steady. It is pointed out that the efficiency of the "Venus" arc lamp is considerably higher than that of the tungsten incandescent lamp, with which it is compared. The lamp is built for alternating current or direct current at 110 volts, or it can be connected two in series on 220-volt circuits if necessary. By using sand-blasted outer globes, or Holophane shades, it may be made to give a soft, mellow light. The carbons used are ¼ in., and the lamp will burn 30 hours without trimming.

"Tinol" Solder.

The American Tinol Company, 2100 Fairmount Avenue, Philadelphia, Pa., is introducing a new solder called "Tinol," which was originated in Germany. It consists of finely granulated solder, each grain being coated with a fatty organic substance neither acid nor alkaline. This coating or "flux" begins to melt before the solder, but is not completely evaporated until the solder has set, thus protecting fully against oxidation during the entire operation. The mixture of granulated solder and fatty flux forms a paste of a consistency that allows its easy application by a knife blade, glazier's spatula, stiff bristle brush, or even with the fingers. As it is convenient for some work to use solder in stick and wire form, "Tinol" is also made up in rods and wires of different sizes, ranging from No. 0 down to No. 18. These rods and wires are all hollow and contain the same flux used in the "Tinol" paste. Any source of heat may be utilized, as a gasolene or alcohol torch, hot poker, the usual copper tool, etc.; for light work an ordinary wax match will answer. One advantage of the fine granulation of the solder is that much less heat is needed than with bar solder, since each grain melts much more readily.

A report of a test made by the German Postoffice, which controls the telegraphs and telephones, states that by the usual method, using ordinary solder, three joints made in an underground cable sleeve of 4½-in. diameter and 14-in. length averaged an hour and between 6 lb. and 8 lb. of solder (including the melting pot waste). On the other hand, with "Tinol" the average per sleeve was reduced to 2½ ounces and 21 minutes of time. Moreover, out of a total of 20 sleeves tested at 50-lb. pressure, all of the "Tinol" joints were sound, while with ordinary solder imperfections in 3 out of every 10 had to be replaced.

The use of "Tinol" is stated to do away with the need of scrupulous cleaning of each wire or strand, to require less time, to give a cleaner joint with less skilled labor, and to eliminate all danger from acid fluxes. For lighter work, such as interior lighting, telephone connections, etc., simply scraping off the insulation, twisting the wires together, smearing on a little "Tinol" paste, and heating with a small torch, or even a wax match, results in a clean and firm joint. A further advantage lies in the ability to prepare a number of joints for soldering and then quickly pass from joint to joint with the torch. As the paste is applied to the cold joint, the awkward handling resulting from the need of simultaneous holding of the wire (frequently necessarily in confined places), the application of the solder and heating is avoided; a helper is therefore not needed and the work, even in confined quarters, is rendered very easy.

In switchboard work a little "Tinol" paste is easily applied to awkward corners by the point of a knife, and a thin hot wire will melt the "Tinol." In connection with work of this character the well-known pyrographic outfits sold by dealers in artists' materials have been found very useful, such an outfit having burning points of various shapes that are readily introduced into places difficult of access. In the most delicate instrument work the method just described has been found to be useful.

An entirely new method of soldering has been found possible in some lines. "Tinol" paste, for example, has been applied to joints and melted by the passage of a sufficiently heavy current; wherever applicable this gave particularly good results due to the heat passing from the inside outward. Brushing the paste on broad surfaces and bringing these together under the requisite pressure and heating in gas furnaces has given good results for quantity work. For lesser quantities, pressing between heated tongues is a neat and effective method. For narrow joints in sheet metal work, the paste is applied to the edge of the joint and then heated in any convenient way, by torch, soldering iron, etc. For wider joints, the paste is thinned down with a little water and applied with a stiff bristle brush. This is then heated with a torch, or otherwise, as may be convenient, until the metal glistens; in this way the entire surface of the joint is at one operation thinly and uniformly coated with clean tin. A second application of paste is then made, the parts laid together under pressure and heated; a perfect union of the entire surface is the result. It is easy in this way to get perfect joints of several inches in width between thin and thick brass, copper, iron, steel, galvanized metal, nickel-plated metal, lead, etc., and perfect joints between any of the dissimilar metals mentioned are also readily made.

Among specimens submitted with the above information by the manufacturer are sheet lead of 0.018 in. thickness, with a joint of 7/16 in. x 3½ in.; sheet lead of 0.018 in. thickness soldered to 0.022 sheet steel with a joint of ½ in. x 3½ in.; two iron plates of 0.117 in. thickness soldered with a joint of 1¾ in. x 4¾ in. Also a lot of various copper wires and cables, with and without sleeves; lead and block tin slip joints, railway signal leads of stranded galvanized wire jointed to iron rods, solder-locked nuts and bolts, etc. Cuts taken through the joints show the completest possible penetration of the solder into the joints.

"Tinol," the patent rights of which is controlled by the above company, is furnished in the shape of paste, rods and wire in varying proportions of tin and lead, ranging from 100 per cent tin to 20 per cent tin and 80 per cent lead.

Multi-Vapo-Gap Lightning Arrester.

In the multi-vapo-gap lightning arrester manufactured by the Lord Electric Company, of New York and Boston, the path provided for the discharge consists of a mechanical vapor cloud, and, inasmuch as it is impossible to transmit a dynamic current by means of the cloud, the arrester is said not to carry the working current. The body of the arrester is a hygroscopic mass holding moisture in suspense in a fixed and definite volume. This suspended moisture is maintained in a static conductor form, and the hygroscopic mass is sealed hermetically in a porcelain housing. The impedance of the arrester is said to be nil, owing to the fact that the globules, although mechanically separated, are extremely close together. This multiplicity of vapor-gaps eliminates the necessity of having an air-gap, and together with the low impedance is said to make the building up of a static charge on the line impossible. A tell-

MULTI-VAPO-GAP LIGHTNING ARRESTER.

tale device, which can also be used to open the circuit, indicates and records the passage of a discharge. The arrester has no moving parts, contains no metal, aside from the terminals, and no carbon in any form. It is made in two forms for station and line and car use, and the terminals are suitably marked so that there can be no mistake made in connections.

Combined Starting Switch and Circuit-Breaker.

Supplementing its line of six-pole oil auto-starters, intended for starting induction motors up to 500 hp, and for voltages of 2500 or less, the Hartman Circuit-Breaker Company, of Mansfield, Ohio, has recently brought out a type of starting switch intended for motors of 30 hp or less, and for potentials up to 600 volts. The starter shown in Figs. 1 and 2 is intended for star-delta connection, by which method a starting voltage of 57.8 per cent can be obtained, without the use of transformers. These starters are also furnished with transformers, the coils being mounted in a cast-iron case, to which is bolted the oil switch, making the layout self-contained. The new starter is a double-throw automatic oil-switch, with six sets of contacts on both starting and running sides. These contacts are made easily removable, and the bridging contact is formed in such manner that it can be reversed and both sides used. The contacts have a continuous carrying capacity of 50 amp, and experience has shown that the current-carrying capacity will improve with use. The contacts are brought together with a powerful toggle action, insuring good contact at all times. Fiber barriers are placed between each set of contacts, and these barriers may be readily dropped for inspection of the contacts, as will be observed in Fig. 2, where the barriers have been dropped on the starting side.

While the starter can be furnished in the non-automatic form, the usual practice is to provide the same with single or double overload coil protection, and it can also be furnished with low-voltage protection on the running side. On the starting side only a portion of the turns of the overload coils are in series—

FIG. 1.—SIX-POLE STARTING SWITCH, WITH DOUBLE OVERLOAD COIL.

usually one-fourth—although this may be varied according to the current required for starting the motor. The starter thus combines the features of a starting switch with those of a circuit-breaker, and neither fuses nor auxiliary circuit-breaker are required in connection with the starting device. The operating handle is made with an inner and outer lever, which feature prevents starting the motor while excessive overload or short-circuit conditions exist, as the switch will return to

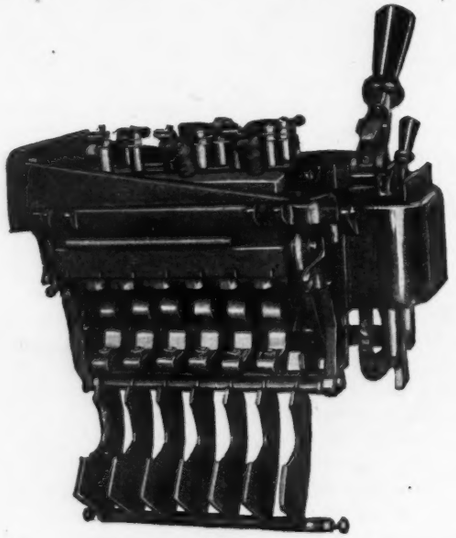


FIG. 2.—STARTING SWITCH WITH OIL TANK REMOVED.

the "off" position regardless of the fact that the handle may be held by the operator.

The starter was designed with a view of making it as near "fool-proof" as it is possible to have such a device. The construction of the operating mechanism is such that it is impossible to throw to the running side first, and it is also impossible for the operator to go off, and leave the switch in the starting position, as it will return to the "off" position when the oper-

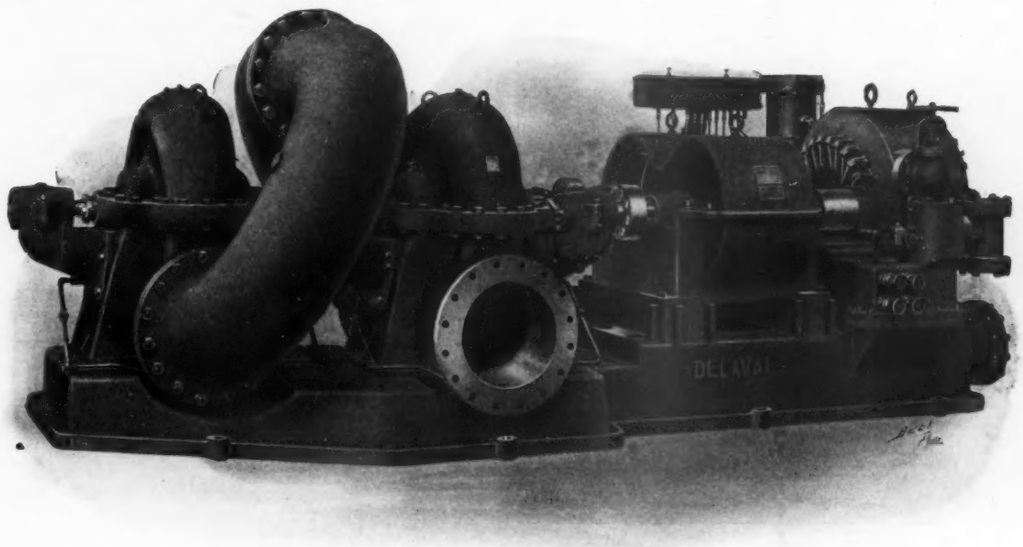
ating handle is released. A quick break is provided when the switch is opened on overload or low voltage, and when tripped by hand from the running side. On the starting side, the construction is such that the operating handle must be thrown quickly from the starting through to the running position, as otherwise, the handle will stop at the "off" position. This feature not only prevents the excessive burning of contacts, but also prevents the slowing down of the motor while passing from the starting to the running side.

Low Pressure Turbines.

There are two general types of low-pressure turbines built by the De Laval Steam Turbine Company, of Trenton, N. J., these being known as the low pressure turbine and the combination high- and low-pressure turbine. The low-pressure turbine is built to operate on low-pressure steam and in case of failure of the low-pressure steam supply the turbine must be fed with steam that has been reduced by means of a reducing valve to a pressure near that of atmosphere. The machine in general is a standard De Laval steam turbine, the only modification being in the steam passages, which have been enlarged to take care of the larger volumes of steam. The wheel, buckets, nozzles, etc., are all of the company's standard construction, the nozzles having practically the same ratio of expansion as those commonly used for high-pressure, non-condensing work. The turbine is built in all sizes from 7 to 300 brake horse-power at various speeds ranging from 3000 to 600 r.p.m. The machine is adapted for driving all types of apparatus now driven by high-pressure turbines.

The combination high- and low-pressure turbine is built to operate either on low-pressure steam or high-pressure steam, as conditions may require. The machine is built with two nozzle compartments; one for high-pressure steam and the other for low-pressure steam. Each compartment is furnished with nozzles having the proper ratio of expansion for the conditions under which they operate. A portion of all of the nozzles are furnished with shut-off valves to allow of the proper regulation of the nozzles for the highest economy under variable conditions. The machine is furnished with two steam connections; one for high-pressure steam and the other for low-pressure steam, each connection leading to its own governor valve, which in turn is driven by a separate governor. The turbine is arranged to be entirely automatic, the low-pressure governor being set for a speed a few revolutions higher than that of the high-pressure governor. On the total or partial failure of the low-pressure steam supply, the machine will automatically draw from the high-pressure steam supply the amount necessary to make up the deficiency. In case of the complete failure of the low-pressure steam supply the machine will operate on high-pressure steam and under this condition will give, it is claimed, practically the same economy as would a steam turbine designed for the high-pressure condition only. The combination high- and low-pressure turbine is built particularly for conditions where continuous operation is essential and where the supply of low-pressure steam is intermittent or is apt to fail completely. The regulation obtained when changing from one steam pressure to the other varies from 2 per cent to 3 per cent, this being taken on an instantaneous change from one condition to the other, such as seldom occurs in actual service. The machine is also arranged with a by-pass valve which allows the admission of high-pressure steam into the low-pressure compartment, enabling the turbine to operate under full-load conditions non-condensing. This by-pass valve is not automatic and is added simply to enable the machine to carry full load in case of failure of the condenser apparatus or during repairs to condenser apparatus.

Both the low-pressure and combination high- and low-pressure turbines are built for a wide range of steam conditions varying from 5 lb. pressure above atmosphere to 10 in. of vacuum on the steam inlet. They are also built for low vacuums in order to meet conditions where the temperature of the circulating water or existing condensers prohibit the maintenance of a high vacuum. The steam consumption of the turbine varies somewhat with the sizes and operating conditions; the manufacturer states that the average machine operating with steam at atmospheric pressure, exhausting into a vacuum of 27 in. to 27½ in. will use from 28 lb. to 32 lb. of steam per brake hp-hour.



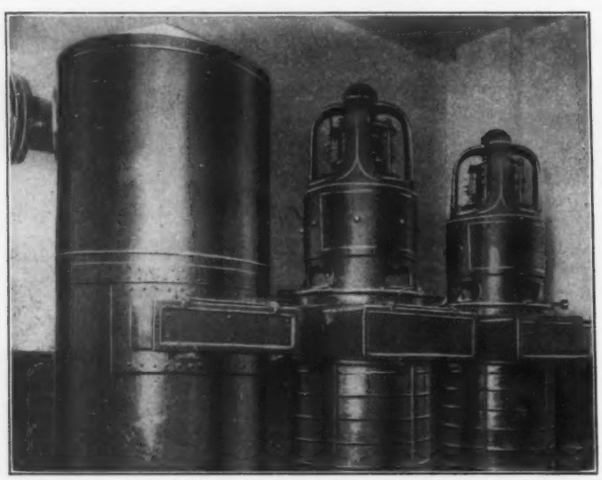
LOW-PRESSURE TURBINE.

The company is also building a high-speed, low-pressure turbine particularly adapted for a direct connection to centrifugal pumps and blowers. This class of machine is built in both the low-pressure and combination high- and low-pressure types and consists of the De Laval wheel which is direct connected to the machinery to be driven by the turbine. On account of the direct connection of the wheel and the elimination of the usual reduction, the machine can only be operated for good economy with high speed and for this reason is not particularly adapted to direct-current generator work, but is particularly adapted for high-speed pumping and blower work, such as power-plant auxiliaries, boiler-feed pumps, elevator pumps, etc.

Vacuum Cleaning Equipment for Office Building.

The Spencer Turbine Cleaner Company, of Hartford, Conn., and New York, has installed in the new Fifth Avenue Building, Madison Square, New York, a complete vacuum cleaning outfit for daily use in cleaning the entire building. The installation is illustrated herewith and consists of an 8-sweeper machine driven by a 20-hp motor, and a 12-sweeper machine driven by a 30-hp motor. These connect with 13 risers in the building, and by means of an installation of 185 valves every part of the building is within convenient reach of a moderate length of hose. In the Spencer turbine cleaner the main element of the system is the exhauster. This consists of a vertical shaft on which the impellers are mounted, the weight of all rotating parts being balanced by the air pressure inside of the surrounding casing. A revolving element driven by a direct-connected motor, together with removable dust-receiving and collecting chambers, two at the top of the impellers just below the motor, and the other at the bottom of the turbine below the impellers, constitute the whole of the mechanical equipment. The floor space occupied is very small, the base of a 15-hp machine, which operates six cleaning tools at one time, covering a space only 31 in. square.

The dust-laden air enters the top chamber at a tangent, and the resulting whirl of the air deposits in that chamber the



VACUUM CLEANING EQUIPMENT.

heavier dirt; the lighter particles are carried through the turbine, but cause no injury, since there is a clearance of over ⅛ in. between the impellers and the stationary parts. The velocity of the incoming air is constantly increased by each succeeding impeller, so that when it reaches the lower dust-separating chamber, the air near the outer casing is said to be traveling at the rate of a mile a minute. The lighter particles of dust which have passed through the impellers are thrown by centrifugal force against the casing of the machine and dropped to the lower receiving chamber. The air, practically freed from the dust, is then carried through a pipe to a chimney flue or other convenient outlet. The design of the exhauster is such that it will handle a large volume of air, while the suction is practically constant under all conditions of load up to its maximum capacity. The energy required to operate the turbine is stated to be proportional to the load. This follows from the inherent design of the machine, and not by the use of any extraneous appliances. If it is desired to change the tools, or go from room to room, the air can be shut off by a valve in the operating handle. The vacuum maintained at the tool under average conditions is about 3 in., and owing to the large amount of air exhausted, and the large size of tool, larger particles than ordinary are handled, and work is more rapidly performed. With the type of tool used, not only dust and dirt, but such litter as cigar-stumps, matches, nutshells and similar size accumulations are removed by the cleaner.

A feature of the system are the fixtures and tools used in connection with it. The inlet valves are placed flush with the surface of the wall to which they are attached, and the hose coupling is merely pushed into the valve, where it is automatically locked in proper position. When the coupling is removed, the value automatically closes and renders the opening air tight. A special reinforced suction hose of large diameter and light weight is used, a 1¼-in. hose weighing 55 lb. per 100 ft. The line of tools is adapted to cleaning every kind of article in every location. A swivel attachment enables the operator thoroughly and rapidly to clean under and around furniture, around window casings and in similar inaccessible places without changing his position. The width of the slot in the tools varies from ½ in. to ¾ in., and these have given good service on bare floors, hard-wood floors and stone. The apparatus is designed to exhaust 125 cu. ft. of air per minute.

Electric Heating Devices.

The question of efficiency in electric heating devices is entirely one of construction. That is to say, certain metals and substances are better adapted as resistance mediums for heating elements, because they may be contained in the space provided by an iron or other heating device, and have durable

FIG. 1.—"SUPERIOR" IRON.

qualities. The problem which has been difficult of solution has been to obtain, besides a suitable resistance medium, a construction such that the heat is conducted with a minimum loss to the ironing surface, where it is needed. The 6-lb. flatiron brought out by the American Electrical Heater Company, of Detroit, Mich., and illustrated herewith, is claimed to embody a practical solution of this vexed problem. No wire is used in the heating element since this requires a core and disintegrates with age and usage. Heat is generated by a flat element which is said to be a portion of and to cover the entire bottom plate of the iron. An even distribution of heat is said to result without much loss. The coffee percolator recently placed on the market by this company is shown in Fig. 2. This device does not boil the coffee, but starts to percolate after the circuit has been closed and by the time the liquid reaches the boiling point the beverage is ready to serve. A new disk

FIG. 2.—"AMERICAN UNIVERSAL" COFFEE PERCOLATOR. FIG. 3.—DISK HEATER.

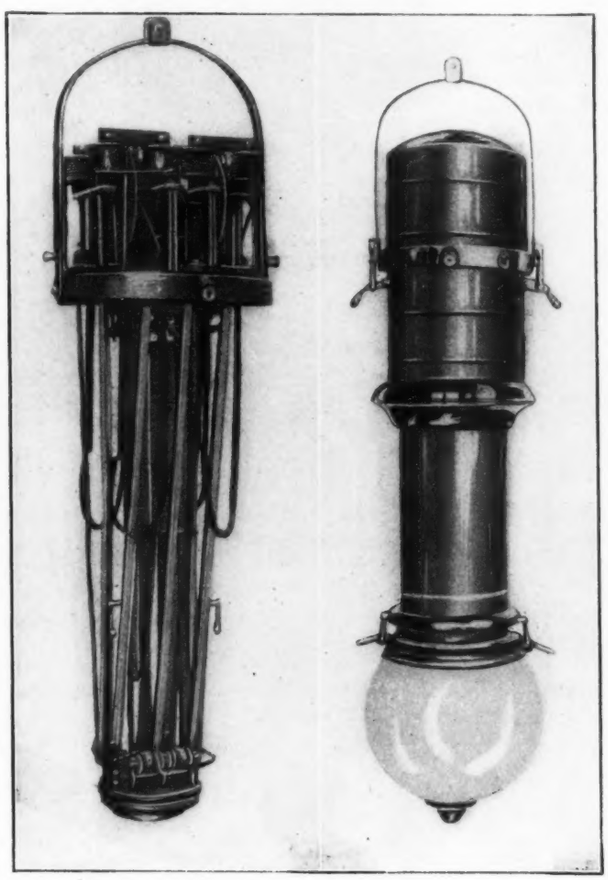
heater, suitable for a great many purposes, is shown in Fig. 3. This device is provided with a steel-clad element which is efficient and durable and instantly replaceable. It is highly finished and provided with ebonoid handles and heat-insulated legs, to prevent it from scorching or scratching polished surfaces.

Toerring Flaming-Arc Lamp.

The C. J. Toerring Company, of Philadelphia, has placed upon the market the flaming-arc lamp shown in the accompanying illustration, which is claimed to combine simplicity in street wiring, rigidity of construction, rapid trimming and general durability and reliability.

As is well known, the flaming arc requires a drop across its lamp terminals of only 55 volts, making it necessary to burn two lamps in series on 110 volts. If these lamps are spaced at a considerable distance, the wiring involved is a considerable item. The method heretofore used has been to burn two lamps on a pole, which requires just double equipment as far as globes, etc., are concerned and double the time to trim and clean the lamps.

To eliminate these very considerable items in maintenance, the present lamp is so constructed that it can be hung directly



FLAMING-ARC LAMP.

across a 110-volt line, running two arcs in series within a single globe. Each arc is dependent on its own regulating mechanism, which insures a perfect burning and regulation that would not be possible were the two arcs regulated by a common feeding device. The regulation of each arc for an alternating system is provided by a rotating aluminum disk actuated by a series and a shunt magnet, whereby a chain run on a pulley is unwound to feed the arc, and rewound to lengthen the arc gap. The series coils, blow magnets, arcs and resistance are all in series, each shunt being connected directly across its own arc. The two sets of carbons are trimmed in an inclining position downward, supported by chains from above, which in turn is regulated by its own aluminum-disk motor.

When the current is first thrown on, a pressure of 110 volts actuates the shunts, causing a rapid rotation tending to lower the two sets of carbons. Should one set get together before the other, the shunts, of course, are short-circuited and the downward rotation will stop on that side, the other pair of carbons still continuing down until contact is made at their tips. This closes the series circuit and throws a series current into the series coils, causing a rapid rotation tending to pull the carbons upward and apart. As soon as these tips are pulled apart, however, a small shunt current immediately begins to flow, which, at a definite height of the carbons in the economizer, will cause a balance and the disk will become stationary. The arcs are now each burning at its required voltage and at a designated point in the economizer a definite distance from the blow magnet pole tips which stretch them and hold them rigidly on the carbon tips. As the carbon burns away, causing the arc gap to increase, the shunts predominate and slowly unwind the pulleys, lowering the carbons as they are consumed. This gives an ideal feed, as the carbons by this method are always being fed a little and with a smooth, steady motion only as far as needed. Should an imperfection in the carbon cause an over-feed—that is, lowering the tips too low momentarily—the series magnet will immediately predominate and pull them back to the desired point once more. Over-feeds are impossible, as are also short and jerky feeds due to the crumbling away of the carbon on a copper support, or any other method of feeding.

The construction of the lamp is such that all moving parts are enclosed in a weather and dust-proof cap, which never has to be removed by the trimmer. The castings and guide rods have been made extra heavy to avoid buckling, and all chances for grounds and short-circuits have been eliminated. All possible parts are made of brass heavily nickeled, the essential iron pieces being japanned. Beaded insulation and asbestos-coated wire are used exclusively, and the guide plate on the base through which the carbons run are one solid piece of fireproof stone which will not crack under heat. The casings are so ventilated as to prevent any ash getting to the upper lamp parts.

The efficiency of these lamps is stated to be about ⅛ watt per candle-power. They are usually hung on 25-ft. poles, either in one straight line through the middle of the street or staggered on both sides of the street to be lighted.

Vibrator and Hair-Drier.

The pedestal vibrator built by the James Barker Iron Foundry & Machine Works, and illustrated by Fig. 1, is equipped with a slow-speed series motor making it applicable to direct-current and alternating-current circuits. Speed variations are obtained

FIG. 1.—PEDESTAL VIBRATOR.

through step pulleys and belt, and this is said to lessen in a measure the noise of operation and vibration of the handle. There are no reciprocating parts in the mechanism and all running parts are immersed in oil. The universal handle employed permits the flexible shaft to assume easy and natural

curves. Phosphor bronze or hardened and ground steel is used in the bearings and the moving parts are encased in such a way that accident is impossible. A wide assortment of applications is manufactured by the company. The hair drier, which is illustrated in Fig. 2, produces a strong breeze of electrically heated air.

FIG. 2.—HAIR DRIER.

The button switch shown on the motor in the illustration changes the wind instantly from hot to cold by merely switching the heating element employed out of circuit. A universal motor is used and the entire mechanism is enclosed and protected by screens. The machine is small and neat in appearance and, the manufacturer says, does not give evidence of the amount of wind and heat produced. Wherever possible the parts are made of aluminum.

Tungsten Lamp Shipping Case.

The accompanying illustration shows a shipping case for tungsten lamps made by the Sefton Manufacturing Company,

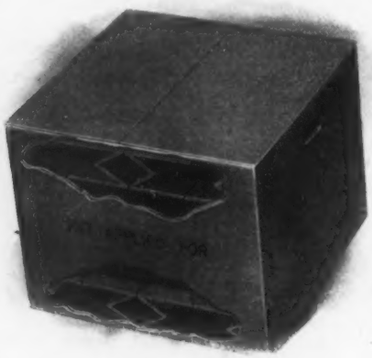


FIG. 1.—CASE READY FOR SHIPMENT.

of Chicago. The cases are constructed of heavy corrugated paper; in the illustration the case is shown with the closing flaps turned up. In each of the corners is an ingenious paper spring, which, together with a top and bottom spring (one of which is shown outside of the case), forms shock absorbers for the inner case containing the lamps. The inner case will hold 50 or more lamps.

In a recent test trip, made by the makers, 50 tungsten lamps

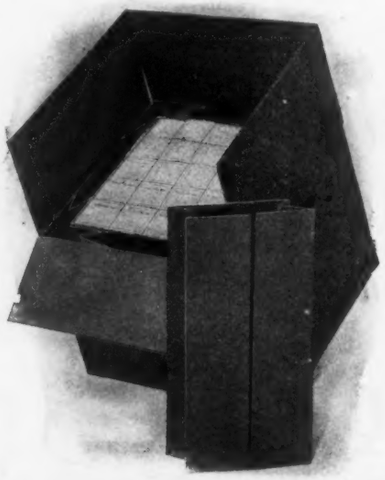


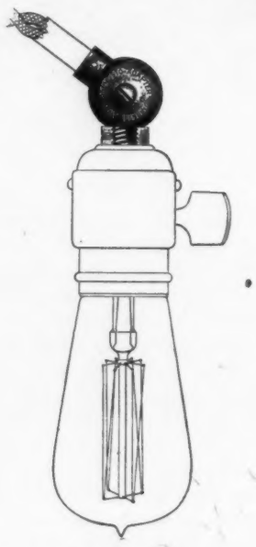
FIG. 2.—CASE FILLED WITH TUNGSTEN LAMPS.

were shipped in a Sefton case by express from Chicago to New York and returned without the breakage of a single filament.

Adapter for Tungsten Lamps.

The tungsten lamp lasting longest when burned in a pendant position, it is necessary to use some form of adapter when connecting it to the ordinary chandelier socket, which points at an angle of about 45 deg. The Frank Mossberg Company, of Attleboro, Mass., manufactures the "Tungsto" adapter illustrated herewith.

The "Tungsto" adapter is applicable to any style of fixture and is interposed between the socket and the steam as indicated.



ADAPTER FOR TUNGSTEN LAMPS.

The adapter is made in various finishes and holds the lamp rigidly in proper position.

Transformers with Improved Steel Cores.

The alloy steel recently invented has made possible many improvements both in the design and in the operation of transformers, so that many manufacturers have adapted their designs to the alloy steel and thus kept their output in the forefront.

Among the list of manufacturers is the Wagner Electric Manufacturing Company, of St. Louis, Mo., one of the pioneers in transformer design and manufacture. In its new line of transformers the company has given thorough consideration to such questions as leakage current, ability to carry excess voltage, proper ratio between iron and copper losses, parallel operation, equipment of taps for varying the ratio, method of insulation and facility of repairs, points having a new significance owing to the use of improved steel and changes in design. It is known that by the employment of alloy steel, the allowable maximum temperature may be increased considerably without affecting the life of the transformer because the increase does not age the new steel. Another feature of this core material is its low energy dissipation when subjected to magnetic reversals whereby the core losses are reduced. On the other

FIG. 1.—CENTRAL-STATION TRANSFORMER.

hand, the exciting current is increased and the power factor on open circuit reduced; but if the no-load exciting current represents only a small fraction of the full-load current of the transformer, high power-factor on open circuit is not essential; in fact, under certain conditions low power-factor is to be preferred.

The manufacturer lays particular stress on what is termed "leakage current" and claims that high leakage current involves the loading up of transmission lines and generators with apparatus having unnecessarily low power-factor, and that transformers possessing high-leakage current will not withstand reasonable excesses in line voltage. This would indicate that transformers having low iron loss but high-leakage current at normal pressure will have excessive iron losses under increased line pressure.

With relation to the proper ratio between copper and iron losses, the Wagner company points out that the desire for a transformer with high all-day efficiency may lead to abnormal design as to the division of losses between the iron and copper.

For instance, a transformer with 100 watts total loss might be designed with 20 watts iron loss and 80 watts copper loss at full load, or with 50 watts iron loss and 50 watts copper loss. While the first would be preferable for strictly lighting service, it would not be so suitable for motor circuits. The company aims toward a balance between all elements. By keeping the copper loss small and minimizing the magnetic leakage, good voltage regulation is obtained—an important feature of a lighting transformer. However, it should be borne in mind that a transformer with good regulation should not be operated in

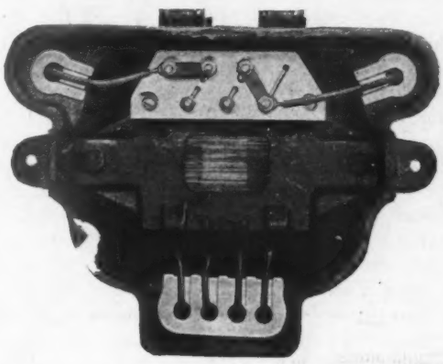


FIG. 2.—CONNECTING BOARD.

parallel with one having poor regulation, since in case of overload the transformer with the better regulation is sure to suffer.

Connecting boards within the case, as shown in Fig. 2, permit the following ratios to be obtained: 1100/2200-110/220; 1180/2160-110/220; 1100/2200-115/230. The windings are insulated in such manner that although impregnation is used, the impregnating compound is not ordinarily relied upon, the windings being insulated sufficiently to withstand the working tension. Facility of repair has been given consideration in the design of the transformers. In the core type, a repair unit is

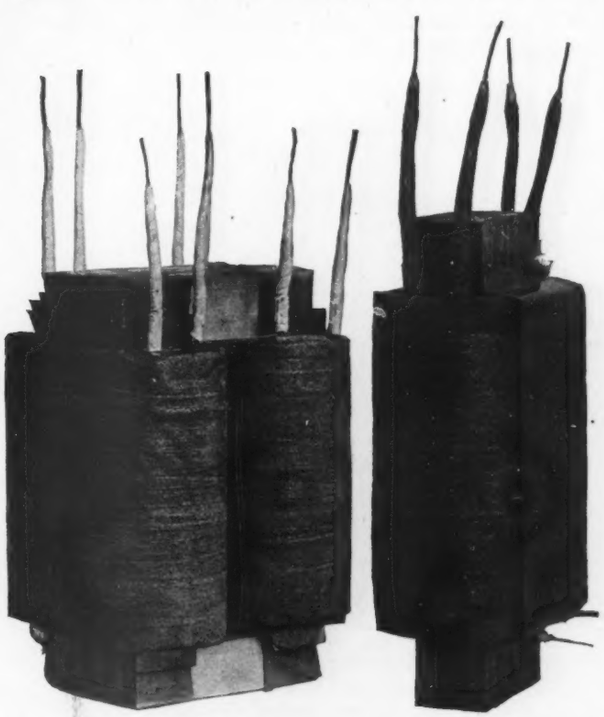


FIG. 3.—CORES OF 10-KW TRANSFORMER. FIG. 4.—REPAIR UNIT FOR CORE-TYPE TRANSFORMER.

furnished consisting of a half-set of primary and secondary windings together with a section of iron core upon which these coils are wound (Fig. 4). Two of these repair units can be

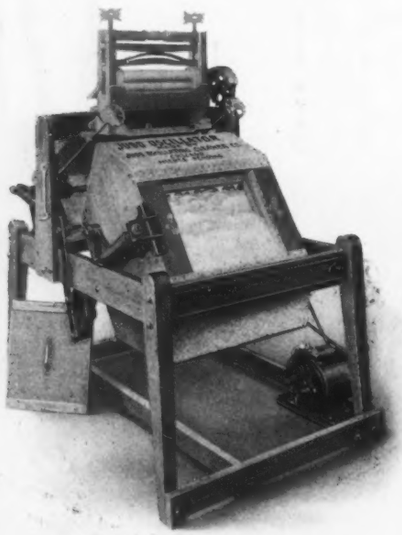
installed by the user in case of complete burn-out. In the shell type, one-half set of primary and secondary windings can be supplied as repair parts, but no iron section is included in this type.

Electrically Driven Washing Machine.

A new oscillating washing machine well adapted for electric drive is that known as the Judd Oscillator and illustrated herewith. The machine consists of a wooden framework supporting a tub of galvanized steel with wooden sides and cover, and also, above the tub, the wringer. The tub is of a new design having, in elevation, six sides of unequal length. An electric motor of ⅛ hp drives, by a round belt and suitable reduction gearing, a shaft at the back of the machine. Two clutches with handwheels are provided, so that the power from this shaft may be used either to oscillate the tub or to drive, through sprocket wheels and chain, the wringer above.

By a crank connection and rocking gear the tub is oscillated 55 or 60 times a minute, making 110 to 120 "throws" of the contents, there being, of course, two dips to each oscillation. But little power is required to oscillate the tub with its contents, because powerful spiral springs are attached to it and these store up energy in one direction to be used in the other, the attraction of gravity also tending to help the oscillating movement.

The tub is partially filled with soapy hot water and the clothes are introduced and the cover clamped down. The machine is then started and rocks from side to side through a vertical plane. The water and air, being lighter than the fabric, are dashed at each downward dip against the pointed ends of the tub first, being turned back by the impact and meeting the clothes on their downward course. This cycle of operations is repeated on the corresponding downward dip on the other side, and it is said that the path of the soapy water and entrained air is similar to a figure ∞, with a loop for each of the two dips of the oscillation. This construction permits the hot soapsuds to permeate the clothes very thoroughly, and it is said that the full capacity of the tub, about 36 pieces



ELECTRICALLY DRIVEN WASHING MACHINE.

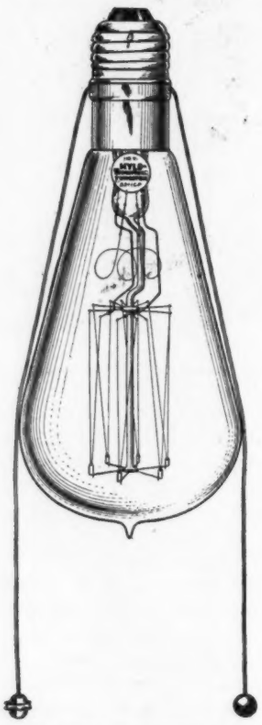
of the average size, can be washed thoroughly clean in five minutes.

After the clothes are clean, the washing machine is stopped by disengaging its clutch, the tub is brought to a horizontal position and fastened there by the hook shown at the left of the frame in the illustration. Then the cover is removed, and, the wringer having been started in operation by the other clutch, the damp clothes may be passed through the wringing machine above, which is conveniently placed for that purpose.

There are five spiral springs on the machine. Four of these are attached to the tub, two on each side, and also to the stationary framework of the machine. They serve a three-fold purpose—to accumulate power, to cushion the blow of the oscillation and to give the final "flip" to the motion which gives the quick return in the figure ∞ cylinder. There is a fifth spring transmitting the power to drive the tub from the rocking gear to a casting attached to the top of the tub. This also serves to give a smooth, uniform motion. The machine cleans itself, and it is asserted to be not only of unusual efficiency, but to satisfy all sanitary requirements. The air and soapsuds are forced through every mesh in the fabrics being washed, and the cleaning is said to be very effective, while at the same time there is no injury to the most delicate laces. With this machine it is said that rubbing is entirely unnecessary and that soaking or boiling of the clothes may be done away with also. Motors for either direct current or alternating current can, of course, be used. The oscillator may be employed for the "dry-cleaning" process as well as for washing clothes with soap and water. The machine illustrated is for household use, but larger sizes for laundries are made by the manufacturer, the Judd Oscillating Cleaner Company, 171 La Salle Street, Chicago.

Turn-Down Tungsten Lamp.

The Economical Electric Lamp Company, of New York, manufacturer of turn-down lamps, has brought out a tungsten turn-down lamp in which the large filament is made of tungsten, and the smaller filament of carbon. The tungsten filament is said to consume 35 watts and to give 27 cp, while the carbon filament consumes 8 watts and gives approximately 1 cp. The



TURN-DOWN TUNGSTEN LAMP.

filaments are connected in parallel, insuring to each its natural life. The tungsten filament is short, and therefore possesses the durability which is inherent in shorter filaments. It is made up in six loops. The lamp is made in both the turn-bulb and pull-string types, and should preferably be used on fixtures adapted to tungsten lamps. At present the lamp is made for circuits of 110 to 125 volts.

Regenerative Flaming-Arc Lamp.

As is well known, flaming-arc lamps in operation evolve fumes from the chemically impregnated electrodes which, if the lamps are not properly ventilated, are deposited on the globe and interfere seriously with the efficiency of the lamps. The Adams-Bagnall Electric Company, of Cleveland, Ohio, has brought out a lamp in which the hitherto objectionable fumes are made to serve a useful purpose, the construction of the lamp being such that the gases generated are circulated by means of side tubes and the matter in suspension thus subjected repeatedly to the action of the arc, with the result that the chemicals exercise their function on the flame many times before finally settling in the bottom of the lamp, and the life of the carbons is greatly increased.

The lamp, which has been appropriately termed a regenerative lamp, is illustrated herewith. The positive or lower electrode is of star-section, the grooves between the eight rays of the star being filled with a chemical composition applied in the form of a paste and finally baked. The component parts of the paste are calcium fluoride, which gives a whitish-yellow color; calcium tungstate, which gives a purple-white color, and sodium tungstate or potassium sulphate, which is added merely to steady the arc. The upper or negative electrode is of high-grade carbon and slides in a tube vertically above it, the positive electrode remaining fixed. Surrounding the arc is a clear-glass cylinder, outside of which is a translucent globe. The inner glass cylinder is in communication with two metal tubes,

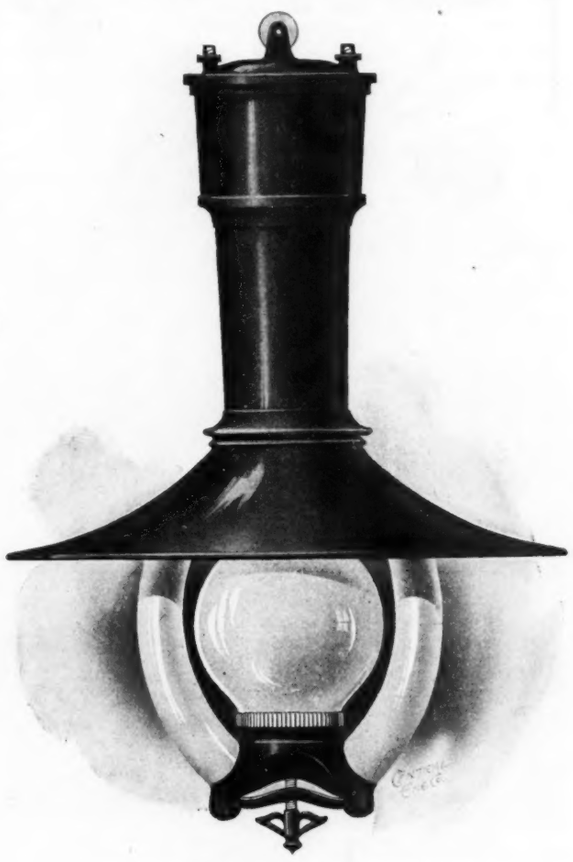


FIG. 1.—REGENERATIVE FLAMING-ARC LAMP.

clearly shown in the illustration, through which the gases descend only to re-enter the bottom of the cylinder, thus being subjected to the high temperature of the arc over and over again.

Because of the high temperature of the gases and also the direct draft past the arc, the inner glass cylinder has no deposit for the greater part of its length, the color and brilliancy of the light being thus constantly maintained although the arc is enclosed.

The resultant light from the arc is of a brilliant yellow color. The spectrum is of the band-and-line type, showing that the gases are incandescing. The upper electrode is 18 in. long and 5/8 in. in diameter, while the lower electrode is 7 in. long

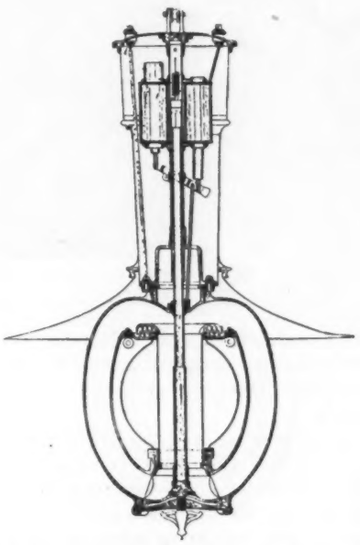


FIG. 2.—SECTIONAL ELEVATION OF LAMP.

and 7/8 in. in diameter. The life of a single pair of electrodes is over 70 hours and their arrangement gives a favorable distribution of light, as is clearly shown in Fig. 3. About 15 grains of the composition are volatilized every hour. The curve shows that a maximum of 3400 cp is obtained at an angle of 40 deg. below the horizontal.

These flaming arc lamps are designed for operation on either

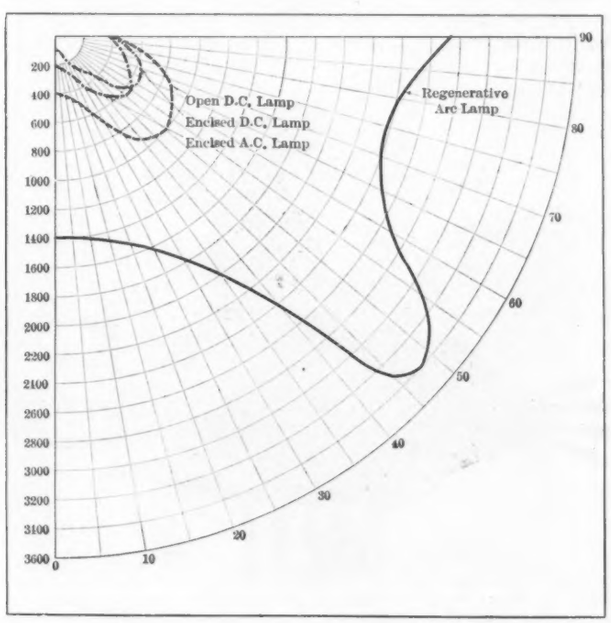


FIG. 3.—CURVES OF LIGHT DISTRIBUTION.

direct-current or alternating-current circuits having a potential of 100 volts to 120 volts. The current consumption on 110 volts is said to be 5 amp, which corresponds to an unusual efficiency even for the flaming arc, which economy is further enhanced commercially by the long life of the electrodes. The lamp gives a mean lower spherical candle-power of 2200, with a consumption of 550 watts.

Porcelain Protective Devices.

The Metropolitan Engineering Company, of Brooklyn, N. Y., has brought out a line of porcelain protective devices which embody distinctive features of unusual interest. The line was

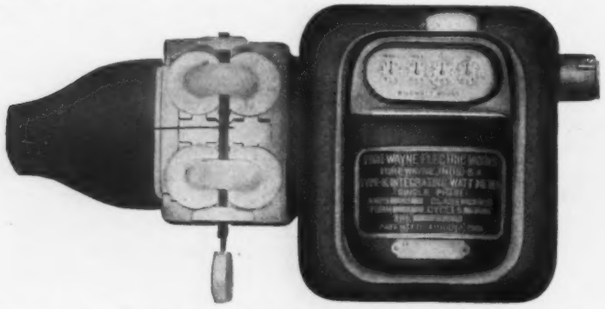


FIG. 1.—METER FITTED WITH OPEN-END CUT-OUT AND METER GUARD FRAME.

designed by Mr. Thomas E. Murray, vice-president and director of the New York Edison Company, and differs from anything now on the market, although serving the same purposes as existing apparatus.

In the line are meter seals, open-end cut-outs and meter guard frames, reversible fuse switches; double-branch, twin-circuit cut-outs; sealable-plug cut-outs, fuses, guards, etc., and the element of protection which these afford to central-station services against criminal tampering with circuits will doubtless appeal to operating managers of lighting companies. Space limitations preclude detailed descriptions of all the features of the line which will be apparent to experienced lighting men from observation of the engravings published herewith. Fig. 1 shows a watt-hour meter fitted with an open-end cut-out and meter guard frame, all parts being in position and sealed. The permanent connections are in the base of the cut-out. The fuses are entirely enclosed in the porcelain handles and by removing the intervening piece of porcelain the neutral connection, where there is one, is open for inspection. By removing the porcelain end piece, connections may be easily made to the terminals. It will be evident that the wires leading to the meter cannot be tampered with except by breaking the seal of some other part of the cut-out and that the type of

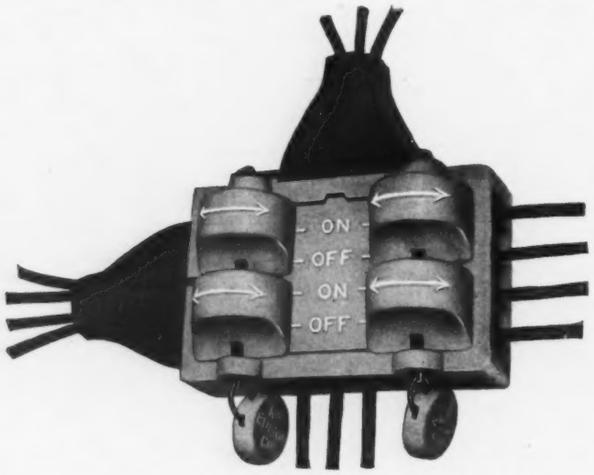


FIG. 2.—THREE-WIRE, DOUBLE-BRANCH, TWIN-CIRCUIT CUT-OUT.

fuse used precludes the possibility of accident under any conditions whatever when it is being inserted. Through the agency of a tell-tale pin hole, the porcelain blackens when a fuse blows so that a defective fuse is thus indicated. The three-wire, double-branch, twin-circuit cut-out shown in Fig. 2 is fitted with reversible on-and-off fuses. A device of this kind is capable of wide application. In apartment house work, for instance, if the tenant vacates, it is an easy matter to cut out the service by simply reversing the fuse handles. This not only breaks the connection but also indicates that it is broken and by means of the seal no change can be made by an unauthorized person without detection. A single branch plug cut-out with sealable features is shown in Fig. 4. With the

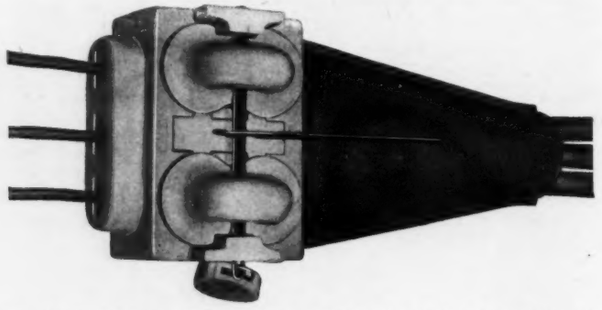


FIG. 3.—CUT-OUT WITH FUSES, TERMINAL GUARD AND SEAL IN PLACE.

porcelain cover and fuses in position, the copper bar is passed through slots in the fuse handle and the leads sealed against

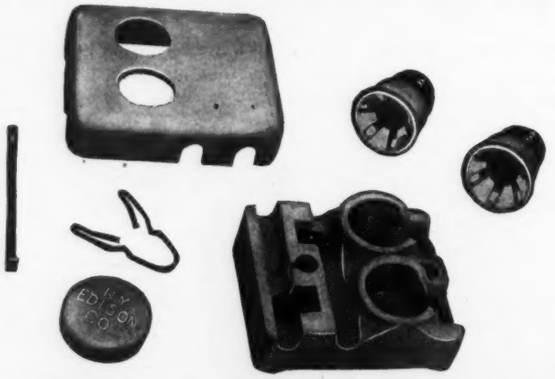


FIG. 4.—SINGLE-BRANCH, TWO-WIRE PLUG CUT-OUT.

interference. Fig. 3 shows a standard cut-out with fuses, terminal guard and seal in place, and Fig. 5 shows a single-

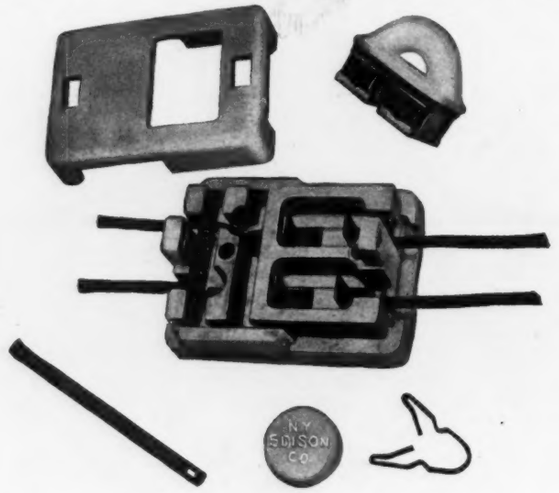


FIG. 5.—SINGLE-BRANCH, TWO-WIRE CUT-OUT.

branch, two-wire cut-out with detachable fuse handle. This illustration shows the type of fuse used and the large contact surfaces provided. It is needless to state that all of the devices have been subjected to rigid tests which they have withstood. Emanating from a practical central-station man, familiar with every detail of the business and knowing the need of such devices, it is safe to assume that the line will meet the claims made for it in practice.

Protected Service Connection Block.

However great his faith in human nature, even central-station managers know that an exposed cut-out and service switch is

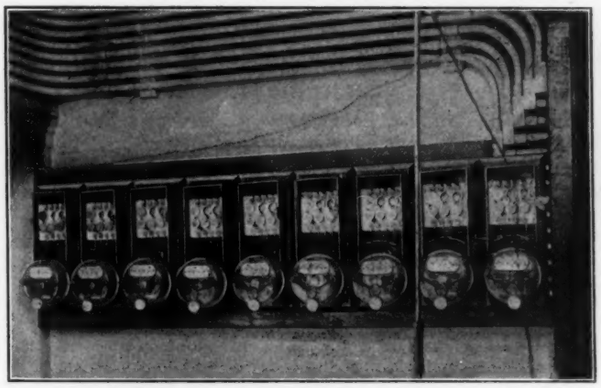


FIG. 1.—PROTECTED METER INSTALLATION.

a source of temptation to which many consumers have yielded. Many managers have sought to apprehend the culprits and bring them to justice, while others have tried to remove the temptation. As a result of the latter effort many forms of protected cut-outs, sealed service switches, etc., have made their appearance. Keeping step with the developments of this particular phase of central-station trouble, the Price-McKinlock Company, of Boston, Mass., is marketing a number of service protective devices designed to cure this evil, one of which, a fuse block cover, has already been described in our columns. The connection block is illustrated herewith. Where it is desirable and practicable to carry the service wires in conduit directly to the meter, this block offers a means of terminating the conduit at the meter and taking the wires into and out of the meter without leaving any exposed leads or connections. The enclosing box is so made that line and load wires may be brought in on either side as desired. It fits snugly against the meter, protecting one or more of its supporting screws so that it is impossible to disturb the meter connection or remove the meter from the wall without breaking the seals of the connection block cover.

Three important features of the device include, first, a practical terminal for the line and service wires to the customer's meter; second, a method for mounting and dismounting the meter without interrupting the customer's service; third, the terminals and disconnecting plugs or straps are so arranged that the meter can be cut out of service and into any desired test connection by a simple operation that does not involve the hazard of a short circuit or require the use of cumbersome

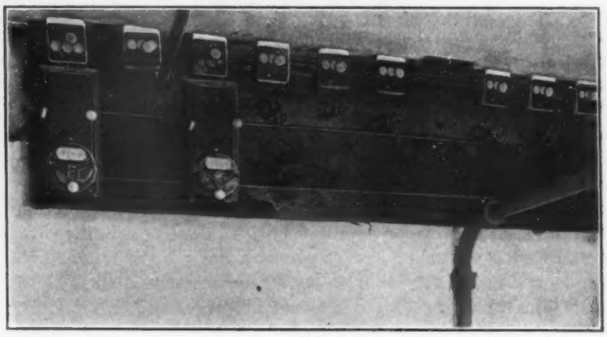


FIG. 3.—PARTIALLY CONNECTED SERVICES.

connection straps or terminals and without interrupting the customer's supply. With the use of this device it is possible so to install meters that the likelihood of theft of energy is largely removed, the speed and accuracy of meter testing is increased and, consequently, the cost of such tests greatly reduced.

Fig. 1 shows a meter installation thus protected on the circuits of the United Electric Light & Power Company of New York. There are six screw plugs provided, four for fuse plugs and two for switching purposes. By means of the latter an inspector may test a meter without cutting a wire, opening a taped joint, or interrupting the customer's service for an instant. The two upper right-hand receptacles are arranged to take specially designed connecting plugs so that ordinary fuse plugs cannot be inserted in these two receptacles.

By screwing the connection plugs into their sockets, the meter is by-passed and the consumer's supply uninterruptedly continued. By removing the other plugs the meter is disconnected from both load and line and may be removed or replaced without the use of any instrument other than a screwdriver, or, if a test is desired, any combination of connections may be made, the by-pass plugs then removed and the test made. The special-

FIG. 2.—VIEWS OF SAME INSTALLATION WITH AND WITHOUT CONNECTION BLOCKS AND PROTECTIVE DEVICES.

ly designed by-passing plugs cannot be left inserted in the receptacles, as it is impossible to replace the cover of the device until these plugs have been removed.

The use of the block greatly facilitates meter testing, especially in laboratory work, when testing one or more instruments with a standard where it is desirable to remove an instrument from its connection without disturbing the others. In addition to possessing the element of protection, the outfit is convenient for installations in apartment houses where tenants move with frequency and where meters are disconnected and reconnected at intervals. By the use of such a device the meter may be left in place but disconnected, or the meter may be removed entirely and the cut-out closed and sealed.

As an illustration of the advantages possessed by the device over former methods, Fig. 2 will be interesting. This gives two views of the same installation; one showing a good installation of meters under former conditions with latent possibilities for theft of energy; and the other shows a meter installation with the connection blocks and protective devices installed.

An illustration showing the use of the two protective devices, namely, the fuse block cover and the meter connection block, is given in Fig. 3. Here the meters controlling the apartments

FIG. 4.—PROJECTED CUT-OUT.

FIG. 5.—PROTECTED METER.

are all located in the basement. Each cut-out, placed by the electrical contractor, has been covered with the device described and placed under seal. But two of the apartments have been cut into service and here meters are placed with the connection block, the covers sealing the cut-outs reversed, fuses installed and again placed under seal. The remaining seven vacant apartments where service has not yet been established, show all of the terminals protected by the fuse-block covers. Loops brought out under these cut-outs are "dead," as the fuses in the cut-outs have not been placed.

When service is installed the cover is reversed to its normal position and sealed, making the fuses accessible, but at the same time making it impossible to place a "jumper" or otherwise tamper with the connection without breaking the company's seal. The illustration shows these covers both with service cut in and cut out. Where the service is in use the fuses are visible, and where discontinued the white circles are simply the porcelain of the cut-out block showing through the holes in the iron cover.

Fig. 4 shows the installation of one of these cut-out covers within a cabinet furnished and placed by the electrical contractor. Here the customer has not been connected, the cut-out terminals are under seal and no fuses installed. When service is cut in the cover will be reversed, the fuses inserted and the cover again sealed.

Fig. 5 shows the meter as it leaves the central-station company's storeroom, equipped with the meter connection block and mounted on a board which is secured to the wall on the customer's premises. The box is, of course, not under seal until after installation.

Automatic Intercommunicating Telephone Equipment.

The increasing demand for intercommunicating telephone service throughout the country has induced the Western Electric Company, which supplies all the equipment used by the entire Bell system, to place on the market two types of metal

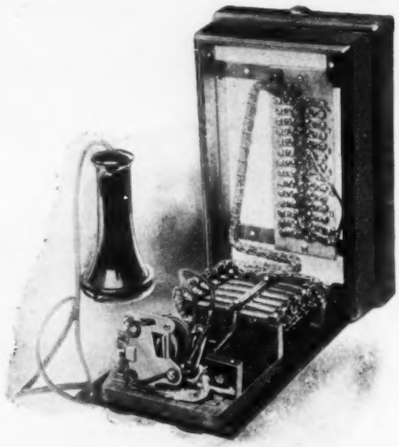


FIG. 1.—ARRANGEMENT OF NON-FLUSH WALL SET.

automatic intercommunicating telephone equipment. These sets are made in two types, a non-flush set for mounting on a wall and a flush set for mounting in a wall, both compactly mounted in a fireproof iron case, having a hard, durable, black japanned finish with nickel trimmings.

The non-flush wall set has all the telephone apparatus mounted on a door, which is hinged at the bottom so that it

FIG. 2.—ARRANGEMENT OF FLUSH WALL SET.

can be swung down as in Fig. 1. To make the apparatus accessible for maintenance and inspection, all current-carrying parts, including the transmitter, are insulated from the case and a concealed binding post receiver is used. A noticeable feature of this set is the dustproof side used in connection

with the switch hook to prevent dust from entering the case through the switch-hook slot.

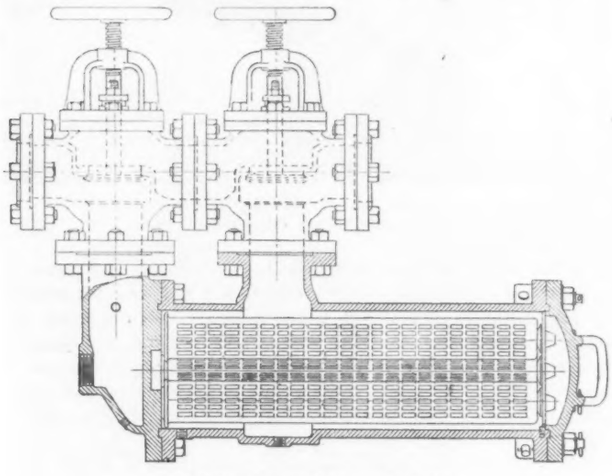
The flush-wall set, Fig. 2, not only possesses all the features of the non-flush type, but in addition the front of the set is removable from the back, thus permitting the back of the set to be used as an outlet box. This set may be placed in a residence or building while the building is under construction, or in an old building before the wiring is started, and the front of the set containing all the working parts fastened in place when convenient. This will doubtless appeal to contractors and those installing sets in old or new buildings. The superintendent's call equipment can be furnished for any of the stations to enable a general call being given throughout the system for the superintendent, who may be in one or another of the departments.

Either full metallic or common return wiring may be used to connect the stations together. The former renders the system less subject to inductive disturbances and cross-talk, and is recommended when the system is to be connected to an exchange or outside service. If the maximum distance between any two stations is 500 ft. or less the ringing battery should have a potential of about four volts and the talking battery a potential about the same as this. With 1200 ft. as a maximum distance, the potential of the ringing battery should be five volts and of the talking battery four volts. With 2000 ft. as the maximum distance the ringing battery should have a potential of 7 volts, and the talking battery of 6 volts. These sets have a capacity of 12 stations, each set being provided with 12 buttons, one button for each station. The name-plate is provided with a space opposite each button for designating the name or location of the station associated with the button. For the sake of convenience the same button is used for signaling the station desired by the caller, and for establishing telephone connection.

Feed-Water Grease Extractor.

The accompanying illustration shows the details of the feed-water grease extractor which has been brought out by the American Steam Gage & Valve Manufacturing Company, of Boston, Mass.

Two valves forming the inlet and discharge from the extractor, when seated as shown, force the water into the shell of the extractor through the cartridges, and in this manner the grease is extracted. Where the valves are on the lower seat they form a by-pass, so that the shell of the extractor can be opened and



FEED-WATER GREASE EXTRACTOR.

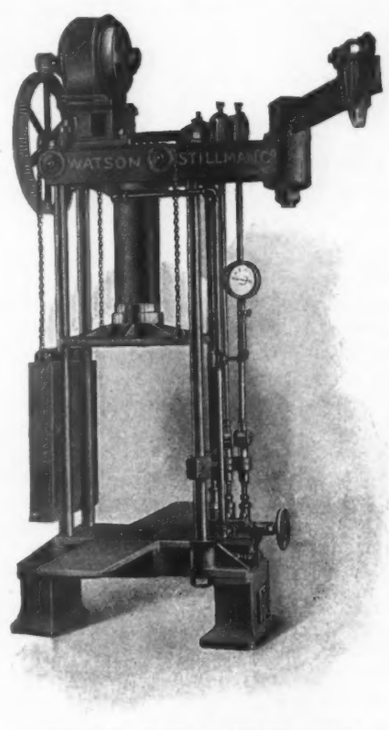
the cartridges taken out, and either replaced by an extra set or cleaned and put back. The ratio of the openings in the cartridges to the inlet of the extractor is as 48 to 1. The cartridges are held firmly in place by seating them on the base, and by plate and spring washers at the top. Pressure gages are applied to both the main chamber and base, so as to note the difference in pressure, and ascertain when the pressure in the main casing is increased, due to the restricted flow of the water by the covering of the cartridges becoming filled with grease.

Means have been provided in the base for ¼-in. steam connection, through which steam is admitted into the inside of the cartridges, and in this manner the latter may be cleaned, so that frequent removal of them will be unnecessary. The shell of the extractor is small and compact, and the manufacturer directs attention to the shape of the cartridges, which are triangular and thus may be placed in a comparatively small space. A feature of the outfit is that it may be placed in any position, and can be connected directly to the operating valves or to the valves in a pipe line.

Reversed Cylinder Forcing Press.

The Watson-Stillman Company, New York, has just introduced a new reversed cylinder forcing press, as a handy tool for pressing bearings and for miscellaneous work. As will be seen from the illustration, a crane bracket and beam extending from one end enables the operator to swing a heavy piece of work onto bracket shelves extending out from each side of the bottom platen. These shelves, 30 in. long by 12 in. wide, are detachable, can be lifted off on jobs where they would be in the way, and are sufficiently strong to support any work that will go into the machine. They will be appreciated by those who have had to push castings or parts into place on the ordinary small platen.

The motor, mounted upon pedestals on top of the press, drives the pump shaft through single-reduction gearing. A hand or belted drive is furnished if desired instead of the motor. On the other end of the pump shaft are two eccentrics, each driving one of the pistons of a ¾-in. x 2-in. twin pump, for which the pedestal legs act as reservoirs. The operating valve is of the single-screw stem type, and connected to release the pressure



REVERSED CYLINDER FORCING PRESS.

from the work when opened, and start the ram down when closed. It will not retain the pressure unless the motor is stopped or the liquid driven through the safety valve. Other types of valves may be substituted to meet special conditions. A gage is furnished to read in tons or pounds per square inch, as desired.

Tungsten Sign Lighting.

The various companies belonging to the National Electric Lamp Association are now supplying a low-voltage tungsten sign lamp which consumes 5 watts, is rated at 3¼ cp and has a life of 2000 hours at constant voltage. Briefly described, the lamp consists of a V-shaped tungsten filament mounted in a bulb 1¾ in. in diameter and 3¼ in. in length over all, this being the same size as the 4-cp carbon sign lamp.

Figs. 1 and 2 show the tungsten and carbon sign lamps in comparative size. The substantial method for mounting the tungsten filament is made possible by the low potential, 8 volts to 12 volts, at which these lamps are designed to operate. A low voltage, other things being equal, means a short, thick filament. With the "double-coil" carbon lamp considerable trouble has been experienced from static electricity, which causes the filament to be attracted against the inside of the bulb. The heat of the incandescent carbon cracks the glass, allowing air to leak in, and the lamp immediately burns out. Sometimes the process of cleaning or dusting the bulbs will induce enough static electricity to cause premature burn-outs. This annoyance is entirely overcome in the low-voltage tungsten lamp by the large clearance between filament and glass.

Of course, it is not possible to operate low-voltage lamps directly on commercial circuits of 110 volts or thereabouts, and therefore for direct-current systems it is customary to use a multiple-series arrangement—for example, 11 groups in series, each group consisting of 20 10-volt lamps in multiple. For alternating-current systems it is very convenient to employ one

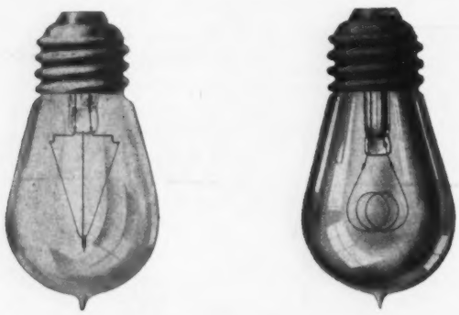


FIG. 1.—TUNGSTEN SIGN LAMP. V-SHAPED, ANCHORED FILAMENT.
FIG. 2.—CARBON SIGN LAMP. DOUBLE-COIL UNANCHORED FILAMENT.

of the numerous types of sign-lighting transformers or compensators which are now regularly upon the market in capacities ranging from 50 watts up to 1 kw. These transforming devices have an efficiency of 92 per cent and upward, making the total consumption of the sign lamp, when transformer losses are charged up to it, 5.4 watts.

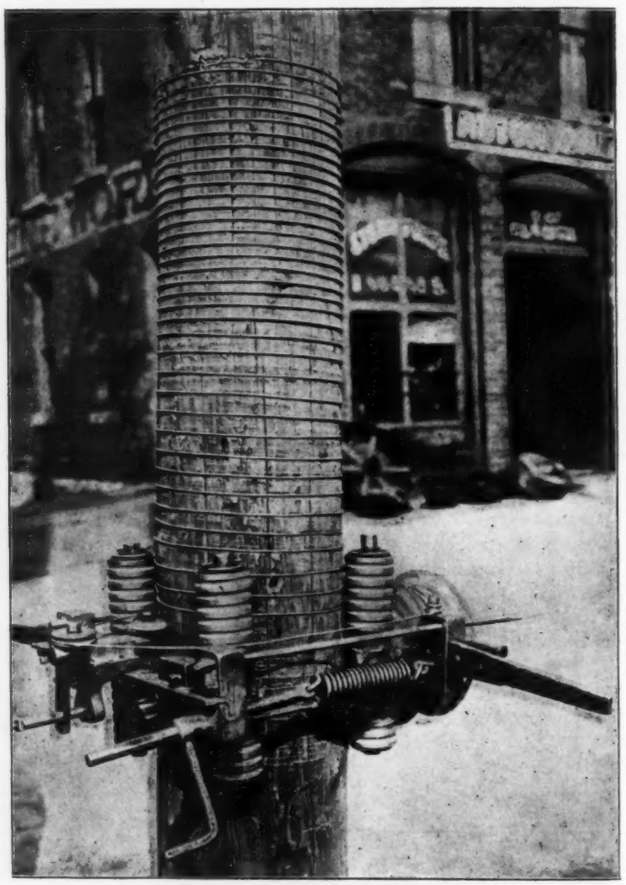
One of the principal features that conduce to the wide use of the new tungsten lamp is the saving in power consumption made possible by its use. The lamp consumes less than 30 per cent as much energy as the 4-cp carbon, which fact appeals forcibly to electric lighting companies which supply energy and renewals for electric signs on a flat-rate basis. The extravagance of the ordinary sign lamp is evident when one remembers that 52.4-cp carbon lamps consume 1 kw—as much as the maximum lighting demand of an ordinary residence.

From the consumer's point of view the tungsten lamp is equally desirable, as in most cases its use will result in a considerably cheaper rate for electric displays. The central station can obviously afford to lower its flat rate when it is effecting a saving of 70 per cent or over in current. While the tungsten lamp is higher in price than the carbon lamp, due to greater difficulties in manufacture, this is much more than compensated for by its great saving in power and long life. It can be shown that for all costs for energy above 1 cent per kw-hour the tungsten sign lamp and equipment cost less to operate, for equal illumination, than does the carbon lamp.

A Pole Wrapping Machine.

The Lincoln Pole Wrapper Company, of Lincoln, Neb., exhibited a machine at the Omaha electrical show which has been very successfully used in Nebraska for the wrapping of electric light and telephone poles in locations where horses are likely to gnaw the poles. The wrapping of wooden poles with wire to prevent gnawing by horses or splitting has been a very tedious and expensive process as usually performed by hand. If well done it is very hard work for linemen and therefore progress is slow. This machine, which is illustrated herewith, consists of a reel, the tension of which can be adjusted; four grooved rollers held to the pole by a couple of spiral springs, and a wheel which acts as a groove cutter in advance of the wire. The machines are designed to use wire from 9 to 12 gage.

It is not necessary that the pole be in perfectly sound condition, as damaged poles can be wrapped as easily as sound ones,



POLE-WRAPPING MACHINE.

since the springs keep a tension on the machine without regard to the shape of the pole. It is claimed that two men can wrap the average pole in from 15 to 20 minutes, which is quite a contrast to the time required to wrap a pole by hand, and makes the purchase of a machine a profitable investment for a company having many poles to wrap, while in small towns the telephone and electric light companies can combine in its purchase.

Only one row of wire staples is needed after a pole is wrapped in this way, as the wire is drawn very tight and is partially embedded in the groove. The machine can also be used for splicing poles, as the pitch or distance between turns of the wire can be adjusted, as desired, by the guide and spacing wheel which acts to cut a groove in the pole in which the wire may be laid.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Irregular weather conditions during the past week have done much to retard advances in retail business. Very little is being done by the wholesalers and jobbers, which is to be expected at this season. A few reorders are being received, but these are mainly for filling-in purposes. The agricultural situation is not materially changed, in spite of the unseasonably cold weather. It is generally conceded that crops will be later than usual, and in some instances lighter. Retailers throughout the country are believed to be very lightly stocked, and the jobbers are preparing for a large business in the fall. In the industrial world there has been considerably more activity. The lower prices for iron and steel brought out a large volume of business, and the mills generally throughout the country are running on full time. So many orders have been booked that the advance in prices has been general for most all steel products, and in many instances wage cuts which were made earlier in the spring are rescinded. Orders for electrical supplies are better than they were a few months ago, but as a rule they continue to be for small apparatus rather than for heavy machinery. So far the orders for steel rails are very backward, although it is known that many companies have their specifications prepared. Collections continue to be only fair, there being little improvement noted from week to week. Business failures for the week ended May 20 were 219 against 244 for the previous week, 284 in the like week of 1908, 165 in 1907, 170 in 1906 and 179 in 1905.

THE COPPER MARKET.

During the past week the condition of the copper market has distinctly improved and a general sentiment seems to prevail that we are on the eve of a material advance. This is made plain by the renewal of speculative activity both at home and abroad and by the apparent awakening of domestic consumers to the belief that they had better lay in stocks at present quotations. Large purchases have been made within the past few days and the selling agencies are kept busy answering inquiries for heavy takings to be delivered June, July and August. The selling agencies are not particularly anxious to acquire this class of contracts at present prices and many melters are finding difficulty in having their demands supplied. The takings for export during the past week have also been very heavy, most of the orders for export, however, running for June and July delivery. The exports for the month of May have been heavy and will probably amount to about 60,000,000 lb., which, taken with the domestic purchases, promise to bring about a reduction in the surplus stock on June 1, instead of the usual increase. Consumption in the United States, it is estimated, is now equal to what it was in 1907, and is about 60 per cent of the record made in 1906. Foreign consumption is about 80 per cent of what it was in 1908. In the mean time production continues at a record rate and there is no denying that the surplus at home and abroad will amount to something like 500,000,000 lb. During the past week prices for electrolytic and casting have been slightly advanced, but present quotations prevail only for moderate lots. Quotations on the Metal Exchange May 24 were:

Lake	13⅛ @ 13⅜
Electrolytic	12⅞ @ 13
Casting	12¾ @ 12⅞

The London prices May 24 were as follows:

	£ s d	£ s d
Standard copper, spot	59 15 0	59 15 0
Standard copper, futures	60 8 9	60 8 9
Market	Easy	Steady
Sales of spot		400 tons
Sales of futures		1,400 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

ALLIS-CHALMERS BUSINESS INCREASING.—It is stated that the business of the Allis-Chalmers Company for the month of April was the largest of any month in the past two years, that it was three times that of April, 1908, and 20 per cent more than that of the same month in 1907. Every branch of the business has shown improvement, but the main growth has been in steam turbines and in gas engines. It is said that within the past 90 days orders for 30 turbines have been taken and that many other orders are in prospect. The fact that the business is up to that of 1907 does not mean, however, that the earnings will be as great, for prices have been very materially lower and many of the new orders will not be delivered until after the end of the company's fiscal year on June 30. It is not likely that there will be any dividend declaration for the preferred stockholders until next year. The improved condition of the company is reflected in the bond market where the Allis-Chalmers 5s are becoming popular and sold last week as high as 86. These bonds were quoted as low as 55 during the early months of 1908. During the past two months a large number of orders have been taken for apparatus for moderate-sized plants, averaging about 400 hp. The aggregate of this class of apparatus will amount to 161,985 hp. Among the electrical companies which have purchased are: The Pacific Gas & Electric Company, San Francisco; Northern Idaho & Montana Power Company, Sand Point, Idaho; Michigan Power Company, Lansing, Mich.; Utah Light & Railway Company, Salt Lake, Utah; La Porte Electric Company, La Porte, Ind.; Detroit United Railways, Detroit, Mich.; Oak Park Power Company, Flint, Mich.; Board of Public Works, Harbor Spring, Mich.; Maumee Electric Company, Maumee, Ohio; Murphysboro Water Works, Electric & Gas Light Company, Murphysboro, Ill.; Intercolonial Railway of Canada, Moncton, N. B.; Milwaukee & Fox River Valley Railway Company, Elkhart Lake, Wis., and Rockford Electric Company, Rockford, Tenn. The Milwaukee Electric Railway & Light Company ordered two 1500-kw motor-generator sets, one 500-kw balancer, six 2000-kw transformers, two 300-kw transformers, two 300-kw motor generator sets and a 300-kw generator of the water-wheel type, much of this apparatus constituting a "repeat" order.

ADDITIONAL 150,000-KW HYDRO-ELECTRIC EQUIPMENT FOR SOUTHERN POWER COMPANY.—The Southern Power Company, Charlotte, N. C., has issued preliminary specifications for 16 hydro-electric units aggregating 150,000 kva for its Wateree station on the Catawba River. The specifications call for 14,000-hp horizontal twin-turbine units at 180 r.p.m., and 8500-kw, 11,000-volt generators, with 85 per cent power factor; also four units consisting of 3000-kw generators coupled to 5200-kw vertical twin turbines. Exciter rheostats, etc., are called for in both specifications. The specifications for switchboard apparatus and transformers will be issued later.

BOSTON ISOLATED PLANTS DISPLACED.—The Jordan-Marsh Company, of Boston, which previously operated an isolated plant, has made a contract for 10 years with the Edison Illuminating Company, of Boston, for electrical power of over 2000 hp and will employ electricity for operating all its elevators, cash-carrier system, fire pumps, etc. R. H. Stearns & Company have abandoned plans for an isolated plant for their new building now being erected, and closed a contract for 26 years with the Edison Company. A contract has also been closed for 50 years with the George A. Carpenter Company for the Blake Building now being erected.

SENATE ADOPTS CARBON TARIFF SCHEDULES.—After a four-hour debate, the Senate on May 21, adopted the Smoot amendment to the Aldrich tariff bill, fixing the duty on lighting carbons at 65 cents per hundred feet for all the better grades of carbons and 35 cents for ordinary coke carbons. This, according to the importers, increases the present rate about 35 per cent. The importers will continue to fight against the new duty and will endeavor to secure a modification when the bill reaches the conference committee.

ELECTRICAL EQUIPMENT OF NEW YORK PIERS.—The North-Eastern Construction Company, of New York, has been awarded the contract for the mechanical and electrical equipment of the new Chelsea piers in the North River. The total amount of the contract is about $750,000. There are nine of these piers in all, the most commodius and modern in New York harbor. They are 800 ft. long and 150 ft. wide, double-deck. Five of the piers will be occupied by the lines of the International Mercantile Maritime Company, comprising the White Star, the Red Star, the American and Atlantic Transport lines; three will be occupied by the Cunard Steamship Company, and one by the Compagnie Generale Transatlantique. The General Electric Company has been given a contract for two 300-kw, three 150-kw, three 100-kw and one 70-kw Curtis turbines. The same company also has a contract for a switchboard of 23 panels. The piers will be equipped with 1000 arc lamps, and the energy will be generated at three separate power stations, one being operated by each of the steamship companies. The contract for wiring has been awarded to the Watson-Flagg Engineering Company, of New York. The power plants will also supply steam for heating the piers. The piers will be equipped with 44 elevators, 64 coaling and cargo winches and 13 baggage conveyors, all of which will be electrically operated. The plans and specifications for this work were prepared by Mr. Henry C. Meyer, Jr., who is the engineer of the steamship companies, subject to the approval of the Department of Docks and Piers. The installation will not be completed for five or six months.

HEAVY ORDERS FOR TRACTION EQUIPMENT.—The railway departments of the Westinghouse plants are said to be busier than ever before in their history. There has been a heavy increase in orders during April and May and this is especially noticeable in the line of electric locomotives. Among the work of this character now being turned out at the shops in East Pittsburgh are three locomotives for the Fort Dodge & Des Moines Railroad Company. Two of these are to be used as freight locomotives and the other as a shifting engine. For the Honolulu Rapid Transit & Railway Company, 30 60-hp railway motors are being made. The Havana Electric Railway Company has sent in an order for a complete substation and powerhouse equipment, consisting of two 1000-hp turbo outfits, four 500-hp rotary converters, 18 transformers, as well as switchboard and auxiliary apparatus. The Wilkes-Barre & Wyoming Valley Traction Company is having 44 100-hp motors constructed. An unusual number of orders for electric mining locomotives have also been placed at the East Pittsburgh electric works. Within the last month these orders have averaged more than one locomotive per day, coming from coal companies in Pennsylvania, Virginia and West Virginia; from iron mines in Minnesota, and from copper, silver and gold mines in the West. Electric locomotives are coming into greater demand than ever for hauling coal from the mines as well as for the general transportation of the mine products.

ROCKFORD (ILL.) CENTRAL STATION TO BE REMODELED.—By increasing its capital stock from $1,000,000 to $2,000,000, in accordance with a certificate filed with the Secretary of State at Springfield, Ill., on May 12, the Rockford Electric Company, of Rockford, Ill., is placed in possession of funds which will be devoted largely to a general remodeling of the main generating station of the company. Work is already under way for this new improvement, and the additions will include two 2000-kw alternating-current turbo-generators, three 750-kw, three-unit motor-generator sets, three 500-hp boilers, chain grates for all boilers, coal- and ash-handling crane with structural runway and coal-bin equipment. To provide room for a portion of the additions the roofs of the engine-room and boiler house of the station will be raised, and advantage will be taken of the change to make the power house practically fireproof. A new overhead traveling crane will be placed in the engine-room, and there will be a new switchboard in a switchboard gallery. The Rockford Company has a deserved reputation for enterprise, and under the management of Mr. F. H. Golding is one of the most successful central-station companies in cities of the size of Rockford.

MILLS BUYING ELECTRICAL EQUIPMENT.—A large installation of squirrel-cage induction motors, aggregating 2200 hp, is being made at the Bonnie Cotton Mills, Kings Mountain, N. C. These motors, which have been furnished by the Crocker-Wheeler Company, of Ampere, N. J., will operate on a 2080-volt, three-phase, 60-cycle circuit. There are 32 machines in all, varying in output from 20 to 100 hp. Each unit is controlled from a separate panel, built of blue Vermont marble. Two 10-kw 2200/110-volt transformers will also be installed in this plant. The Youngstown Sheet & Tube Company, Youngstown, Ohio, has also added to its 5000 hp of Crocker-Wheeler motors by installing a 500-hp synchronous motor. This machine will operate on a three-phase, 25-cycle circuit at the high potential of 6000 volts. It will be used to drive a centrifugal pump. The Indiana Steel Company, Gary, Ind., has placed an order with the same manufacturers for 21 motors, aggregating 655 hp, for rolling mill service. These machines will be used to operate cranes on a 220-volt direct-current circuit.

STAR-FLAMING ARC LAMP.—The star-flame lamp, a new arc-lighting unit claimed to be of unique design and remarkable efficiency, will be introduced at the N. E. L. A. Atlantic City convention. The lamp is the invention of Mr. W. H. Gardiner, of Henry L. Doherty & Company, who is well known to central-station men. The new unit is stated to give remarkable illuminating results, a long series of tests made while the lamp was in actual commercial service showing an efficiency in the lower hemisphere of about three candles per watt. The lamp will be marketed by the Star Electrical Concern, 74 Cortlandt Street, New York, of which A. W. Young is general manager.

NEW HAVEN RAILROAD ELECTRIFICATION.—It has been formally given out that the New York, New Haven & Hartford Railroad Company has perfected its plans for the electrification of another considerable section of its lines. The plans contemplate the installation of electricity on the Harlem Terminal tracks and upon that section between Stamford, Conn., and New Haven. It is said that all four of the tracks through the new cut at New Haven and the Cedar Hills yard will be electrified. No statement was made as to when work will be undertaken, but it was said that it could be completed within 18 months after it is started.

AUTOMOBILES TO DISPLACE HORSE DELIVERY SERVICE OF 66 NEW YORK CITY FIRMS.—The Studebaker Automobile Company has concluded a contract with the Piercy Company, New York City, whereby the delivery service of the latter will be changed over from horses to automobiles. The Piercy Company now supplies delivery services to no less than 66 mercantile and other firms, for which an equipment of 400 horses and 250 delivery wagons and trucks have been necessary. The stable space released and substation garages now being established will give the company accommodation for 500 automobile vehicles.

ELECTRIFICATION ON DELAWARE & HUDSON.—Negotiations are now pending between the Rutland (Vt.) Railway, Light & Power Company, of which G. Tracey Rogers is president, and the Delaware & Hudson Railroad Company with a view to electrifying that company's lines from Castleton to Eagle Bridge, N. Y., and from Fair Haven to Whitehall, N. Y., and operating them in connection with its present lines. If the negotiations now pending are not concluded, the Rutland Railway, Light & Power Company will probably build from Fair Haven, Castleton Corners or Hydeville to Poultney.

STANDARD UNDERGROUND CABLE COMPANY.—The Standard Underground Cable Company has closed supplementary contracts with the Pennsylvania Tunnel & Terminal Railroad Company for 100,000 ft. of duplex, rubber-insulated and lead-covered cable, sizes No. 2-0 and No. 4, to be used on the 2200-volt signal circuit, and also for approximately 20,000 ft. varnished cloth insulated braided cable, sizes ranging from 1,000,000 to 2,000,000 circ. mil. The total amount of the Pennsylvania contract for cable, not including the present supplementary contracts, will amount to 250,000 ft. of triplex 11,000-volt cable, instead of 100,000 ft. as had been stated.

SALE OF WHITNEY COMPANY'S APPARATUS.—The sale under foreclosure of the electrical apparatus which formerly belonged to the Whitney Company, of North Carolina, which was referred to in the issue of May 13, has been set for June 14. The court directs that the apparatus shall be sold at the principal gate of the General Electric Company's plant at Schenectady.

TWO THOUSAND FIVE HUNDRED STEEL REFLECTORS FOR A SILK MILL.—Messrs. Schwarzenbach, Huber & Company have given an order for 2500 Holophane-D'Olier steel reflectors for installation in their silk mills at West Hoboken, N. J.

ASK A HEARING ON NEW YORK CITY BUILDING CODE.—A large number of electrical contractors of New York have signed petitions, addressed to the Board of Aldermen, asking for a public hearing on the new building code. Two reports have been made by the special commission that was appointed to draw up a new law, but no public hearing has been held. The majority report has no section that is especially devoted to electrical construction, but the minority report provides explicit regulations on the subject. As a rule the contractors express themselves as unfamiliar with the meaning of the law, but all are opposed to the ordinance being rushed through without a full opportunity for discussion having been accorded. "What we really want," said one of the leading contractors, "is the adoption by the city of the Underwriters' National Code. This code has been most carefully drawn and can hardly be improved. In addition to that, what we most desire is uniformity, so that we will know exactly what is expected of us. We formerly had to stand three inspections—the city's, the underwriters' and that of the Edison company. Then the Edison people accepted the underwriters' certificate and now we have two inspections. If the city will simply enact that buildings must be electrically constructed according to the underwriters' code and will accept that certificate, it will get the best results, will give us only one inspector to satisfy and will get its inspection done for nothing."

LIQUID GAS COMPANY.—Through a recent announcement that a Bavarian inventor's process for making liquid gas, known as Blaugas, had been sold to a $5,000,000 corporation with Commodore E. C. Benedict as president, and numbering among its directors Judge Gary, chairman of the U. S. Steel Corporation; Theodore N. Vail, president of the American Telegraph & Telephone Company; Theodore P. Shonts, president of the Metropolitan Street Railway, and that a large sum of money had been handed over to the inventor as the purchase price, the public is appraised of another development in industrial progress. This corporation was organized by Franck Z. Maguire and W. W. Gooch, both well known in electrical circles. Mr. Maguire was seen recently by a representative of the *Electrical World* and stated that it would be premature to give information respecting the Blaugas Company of America at the present time, but that he wished to take the opportunity to express his great sympathy with the endeavor of the journal to improve the status of the patent laws. Much of the best inventive work, said he, is now coming from Germany and it is because that country is affording the inventor very much more protection than we do. It is high time to ask the question, "Where are we eventually to finish in this contest, particularly when skilled labor is so much cheaper in Germany than with us?"

WESTINGHOUSE BUSINESS CONTINUES TO EXPAND.—There is a constant betterment manifesting itself in the various departments of the Westinghouse companies. All of the factories at East Pittsburgh, Wilmerding and Swissvale, Pa., have added to their operative forces within recent weeks, owing to the increased influx of orders, and the outlook continues to present encouraging prospects. While the ratio of improvement which set in at the shops of the Westinghouse Machine Company some months ago is still being maintained, the business for the month of May shows an unusual demand for gas engines of large size. The company is now constructing a complete gas producing and power plant for the Southern Cotton Oil Company, of Savannah, Ga., consisting of two bituminous coal gas producers of 300-hp capacity each and a 600-hp horizontal double-acting gas engine.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Fort Leavenworth, Kan.; Fort Hamilton, N. Y.; Pullman, Ill.; Seneca Falls, N. Y.; Logan, Utah; Council Bluffs, Ia.; Galena, Ill.; Des Moines, Ia.; Pullman, Wash.; El Paso, Tex.; Chickasha, Okla.; Halstead, Kan.; Clovis, N. M.; Denver, Col.; Colville, Wash.; Antwerp, Ohio; Galveston, Tex.; Orange, Mass.; Gettysburg, Pa.; Leesburg, Fla.; Geneva, Ala.; Abbeville, Ala.; Jasper, Fla., and Everett, Wash.

AUTOMATIC TELEPHONES FOR HAVANA.—The Automatic Electric Company has been awarded a contract to replace the present manual telephone system in Havana with 6000 automatic telephones. This contract will be completed in the fall, and, it is stated, that by Dec. 1 all of the cities and towns of the Cuban telephone system will be using them.

Financial Intelligence.

THE WEEK IN WALL STREET.

During the past week the Wall Street stock market remained strong, but only moderately active. There is a universal feeling that the tide has turned, and that from this time on business will improve both for the railroads and the industries. For this reason the market is inclined to advance whenever any buying element shows up. There has not as yet been much desire on the part of the outside public to come in, and on this account dealings are largely professional. Under such circumstances it is inevitable that profit taking will occur after every advance of two or three points, bringing about slight reactions. This has been the history of the market for the past several weeks. The strength in the general tone was pointedly demonstrated by the fact that the death of H. H. Rogers, closely identified with many large enterprises, caused not the slightest flurry. Even the stocks in which he was the dominant influence lost only a few points, and these were regained almost immediately. There seems to be no bear interest in the market, and no disposition to seek lower prices. Reports from the steel industry are extremely encouraging, and this has kept the steel stocks among the most active and strongest. During the week shipments to Europe of gold amounted to several million dollars, but apparently this had no effect upon the money market. There seems to be a plentiful supply of cash, and no amount of gold export affects the rates for money. Rates May 24 were call 1½ @ 2 per cent, 90-day 2¼ @2½ per cent. The quotations in the table are those of the close May 24.

NEW YORK.

	May 17.	May 24.	Shares sold.		May 17.	May 24.	Shares sold.
All.-Ch.	16	16	6,100	Int.-Met., pfd..	44½	44⅜	10,400
All.Ch. pfd....	51½	52	7,550	Mackay Cos....	79½	79¼	500
Amal. Cop.....	82¾	83¼	134,346	Mackay Cos.,pfd.	73½	73½*	800
Am. D. T.....	29*	29*	——	Manhattan Elev.	147	147*	1,325
Am. Loc.....	56⅝	57⅜	10,325	Met. St. Ry....	30	27*	100
Am. Loc. pfd...115		115*	500	N.Y. & N.J.Tel.	123*	123*	——
Am. Tel. & Cbl.	77¼*	77¼*	——	Steel, com.....	56⅜	60¼	637,978
Am. T. & T....139⅞		138⅞	14,100	Steel, pfd.....	118¾	119¾	26,992
B. R. T.....	78⅞	79	14,640	W. U. T.....	76	—	12,325
Gen. Elec.....160		160½*	8,200	West'h., com..	84¼	84	12,450
Int.-Met. com...	16¼	16	8,850	West'h., pfd...120		121	1,100

PHILADELPHIA.

	May 17.	May 24.	Shares sold.		May 17.	May 24.	Shares sold.
Am. Rys.....	45¾	45¾	——	Phila. Elec....	12⅜	12½	——
Elec. Co. of A.	12½	12½	——	Phila. R. T....	34⅜	33⅝	——
Elec. Stor. B'ty.	48⅜	48½	——	Phila. Traction.	92½*	92½*	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction.	56¾	57	——

CHICAGO.

	May 17.	May 24.	Shares sold.		May 17.	May 24.	Shares sold.
Chi. City Ry...180*		180*	——	Chi. Tel. Co..134		132½	——
Chi. Rys., Ser.1.109½*		109½*	——	Met. El., com..	19*	19*	——
Chi. Rys., Ser.2.	38½	38¼*	——	Nat'l Carbon..	85	86*	——
Com. Edison...119		119	——	Nat. Carm., pfd.	120*	119*	——
Chi. Subways..	26½	25⅞*	——				

BOSTON.

	May 17.	May 24.	Shares sold.		May 17.	May 24.	Shares sold.
Am. Tel. & Tel.140		138½	——	Mex. Tel.....	2⅞*	3	——
Cum. Tel.....138		138*	——	Mex. Tel., pfd.	5½*	5¼*	——
Edison El. Ill..250		250*	——	N. E. Tel.....133½		132¾	——
Gen. Elec.....160⅞		161	——	W. Tel. & Tel.	12	11½	——
Mass. Elec. Ry.	13½	13½*	——	W. T. & T., pfd	87	87	——
Mass. E. R.,pfd.	71	70¼*	——				

*Last price quoted.
Shares sold are for week May 17 to May 22.

DIVIDENDS.

General Electric Company, quarterly, 2 per cent, payable July 15.

Indianapolis (Ind.) Street Railway Company, 3 per cent, payable July 1.

Norfolk (Va.) Railway & Light Company, semi-annual, 2 per cent, payable June 5.

Rochester (N. Y.) Railway & Light Company, preferred, quarterly, 1¼ per cent, payable June 1.

Sao Paulo (Brazil) Tramway, Light & Power Company, quarterly, 2½ per cent, payable June 1.

CHATTANOOGA ELECTRIC COMPANY SOLD.—E. W. Clark & Company, of Philadelphia, have purchased from the Electrical Securities Corporation, of New York, all of the bonds and stock of the Chattanooga Electric Company, except 200 shares retained by individual directors. The Chattanooga company furnishes light and power for that city, and was capitalized at $750,000 stock and $552,000 of 5 per cent bonds. It is reported that E. W. Clark & Company are also negotiating for the Chattanooga Railways Company.

METROPOLITAN STREET RAILWAY SALE POSTPONED.—The foreclosure sale of the Metropolitan Street Railway Company, which was originally ordered for June 1, and then postponed to June 29, has been postponed until Nov. 18. The sale cannot be held until the United States Circuit Court of Appeals has acted upon the appeal taken by the Guaranty Trust Company from the decree of foreclosure. As this court adjourns on June 30 the appeal could not be heard before that time, and consequently no decision can be reached until fall. The bondholders are still at work upon the reorganization plan, but as yet have given out no details. The foreclosure sale is a part of the reorganization plan, and no effort will be made in that direction except through this sale.

NEW ORLEANS RAILWAY & LIGHT PLAN.—The directors of the New Orleans Railway & Light Company have decided upon a financial plan involving an issue of $50,000,000 of 5 per cent bonds. The plan provides that the preferred and common shareholders shall part with 25 per cent of their stock holdings at 40 and 15 respectively, and a banking firm in New York, which it is stated has agreed to place the bonds, will be represented upon the board of directors. Of the new bonds issued $30,000,000 will be held in the treasury for the purpose of retiring the same amount of 4½ per cent bonds now outstanding, and the other portion of the issue will be placed from time to time as extensions and betterments are required. New Orleans capitalists are still to be in control of the company.

PHILADELPHIA COMPANY'S STOCK INCREASED.—A special meeting of the Philadelphia Company of Pittsburgh will be held July 22 for the purpose of acting upon the plan for increasing the capital of the company from $42,000,000 to $47,000,000. The proposed increase will be in common stock, and will be used especially for the purpose of exchange for convertible debentures of the aggregate value of $5,000,000. Of these debentures $2,500,000 have already been sold to Blair & Company and Ladenberg, Thalmann & Company, of New York. A large part of the proceeds of this sale will be advanced by the Philadelphia company to the Pittsburgh Railways Company and the Allegheny County Light Company for extensions and improvements.

DENVER GAS & ELECTRIC COMPANY.—The stockholders of the Denver Gas & Electric Company have authorized the directors of the company to make a reorganization and a refinancing of the concern; Henry L. Doherty, as president of the company, will have this reorganization in charge. Mr. Doherty is not prepared as yet to give out any details concerning his plans, but it is probable that when the refinancing is accomplished there will be considerable improvement and extension work done in Denver. A contract is now under negotiation between the company and the Central Colorado Power Company. This contract contemplates the purchase by the Denver company of 5000 kw from the power company.

SACRAMENTO VALLEY POWER COMPANY ORGANIZED.—The Sacramento Valley Power Company, which was recently organized at Redding, Cal., has taken over all the properties and water rights of the Northern Light & Power Company and of the Shasta Power Company. These companies owned plants on South Cow Creek, 2000 hp, and on Snow Creek, 1600 hp, with transmission lines into Redding. Additional water rights have been purchased from early settlers on North Battle Creek, from which it is expected to develop 10,000 additional horse-power. For these new rights $100,000 was paid. When all of its plants are in working order the new company expects to develop 15,000 hp.

CHICAGO ELEVATED RAILROAD MERGER.—It became evident last week that the Metropolitan West Side Elevated Railroad Company, of Chicago, was not satisfied with the terms which had been offered by the Central Terminal Company, the new organization which was to act as the leasing concern for the elevated railroad merger. As one of the directors expressed it: "We can do as well ourselves with the property as the offer that is made by the Terminal Company; why, therefore, should we turn over our holdings to some one else?" It is explicity stated, however, that the Metropolitan directors do not intend to break off negotiations.

NEW YORK POWER COMPANY CLAIM HEAVY DAMAGES FROM STATE.—The State Court of Claims, at Rochester, heard last week the argument in the suit of the Fulton, Light, Heat & Power Company against the State of New York for $3,500,000 damages on account of the State having taken possession of the Oswego River for barge canal purposes. This suit is a test case and there are a number of other damage cases of the same character, involving total claims of $10,000,000, brought by other companies that will depend upon the present decision. The power companies claim that their properties have been destroyed by the action of the State.

NEW SURFACE LINE PROPOSED FOR NEW YORK.—Articles of incorporation have been taken out in Albany for the Upper Broadway Railway Company, of New York, with a nominal capital of $750,000. The articles state that the company proposes to operate a double-track surface railway from Manhattan Street along Broadway and St. Nicholas Avenue to Fort George. The incorporators named are unknown either in the financial or traction world, and the plans of the company have not been made public. As yet no application has been made in New York City for a franchise.

DENTON (TEX.) INTERURBAN RAILWAY FOR SALE.—The property of the Denton (Tex.) Railway & Light Company is to be sold under foreclosure sale July 6, 1909. The company was organized several years ago and has constructed 2⅞ miles of track through the main street of the city and planned to extend to Fort Worth, 30 miles away. The company owns a power plant, two cars and considerable real estate. Detailed information concerning the property can be obtained from E. F. Bates, the receiver, Denton, Tex.

KINGS COUNTY LIGHTING COMPANY.—Application has been made by the Kings County Lighting Company to the Public Service Commission for permission to issue $450,000 of 5 per cent first refunding gold bonds. This issue is a portion of the $5,000,000 for which a mortgage was issued to the Central Trust Company in 1904. Previous to this time $1,333,000 of the authorized amount had been issued.

CHICAGO CONSOLIDATED TRACTION.—Judge Grosscup has entered an order authorizing David R. Forgan and John M. Roach, receivers of the Chicago Consolidated Traction Company, to issue receivers' certificates for $550,000, to be expended in making improvements upon the line.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Associated Bell Telephone Operating Companies:					
March, 1909	$10,897,300	$7,919,500	$2,977,800	$613,900	$2,363,900
March, 1908	10,200,800	7,379,700	2,821,100	674,900	2,146,200
Chautauqua Traction Company, Jamestown, N. Y.:					
Quarter ended Dec. 31, 1908	27,061	17,394	9,666	19,796	*10,130
Quarter ended Dec. 31, 1907	26,464	15,013	11,450	12,429	*980
Crosstown Street Railway Company, Buffalo:					
Quarter ended March 31, 1909	196,526	141,708	54,817	50,650	4,167
Quarter ended March 31, 1908	150,362	96,792	53,569	49,013	4,556
Cumberland Telephone & Telegraph Company:					
April, 1909	531,886	299,083	232,803	42,622	190,181
April, 1908	511,378	304,532	206,846	37,582	169,264
Fairmont & Clarksburg (W. Va.) Traction Company:					
March, 1909	29,460	13,189	16,271	1,893	18,003
March, 1908	25,501	11,688	13,813	1,069	15,060
International Railway Company, Buffalo:					
Quarter ended March 31, 1909	995,280	641,600	353,679	285,392	75,111
Quarter ended March 31, 1908	996,815	660,262	336,553	282,430	60,796
Jamestown (N. Y.) Street Railway Company:					
Quarter ended Dec. 31, 1908	39,580	23,864	15,716	16,317	*601
Quarter ended Dec. 31, 1907	32,401	26,705	5,695	15,386	*9,691
Montreal Street Railway Company:					
April, 1909	294,374	173,552	120,822	37,625	83,197
April, 1908	280,736	170,141	110,595	37,495	73,100

*Deficit.

GENERAL NEWS

Construction News.

ABBEVILLE, ALA.—D. G. Zeigler & Company, of Jacksonville, Fla., are preparing plans for the construction of a hydro-electric plant for the Abbeville Power & Manufacturing Company on Abbey Creek, eight miles north of Abbeville, where 8000 hp will be developed. The engineering company will also construct the plant, which will furnish electricity in Abbeville, Dothan, Eufala, Wells, Columbia, Fort Gains, Ala., and Blakely, Ga. The power company has applied for a charter and will be capitalized at $500,000. J. L. Pollard, Dr. C. J. Owens, of Abbeville, and others are interested in the enterprise.

GENEVA, ALA.—The Geneva Power Manufacturing Company has retained D. G. Zeigler & Company, of Jacksonville, Fla., as consulting engineers in connection with the construction of its hydro-electric plant to be located on Double Bridge Creek, about six miles north of Geneva, where 5000 hp will be developed. The power company proposes to build a cotton mill at Geneva. The proposed plant will furnish electricity in Geneva, Enterprise, Hartford, Coffee Springs, Samson and other towns and cotton mills in Alabama. D. O. Vaughn, J. R. Clark, D. G. McInnis, D. H. Morris and A. M. McKinnon, all of Geneva, are interested in the enterprise.

PRATT CITY, ALA.—Arrangements are being made by the Pratt's Home Telephone Company for making improvements to its system, which will involve an expenditure of about $5,000, and will include the installation of a new switchboard.

MESA, ARIZ.—Dr. A. J. Chandler, president of the Consolidated Canal Company, has been granted a franchise to construct and operate an electric street railway in Mesa.

GLENDALE, CAL.—The City Council has passed the resolution demanding the establishment of a municipal electric light plant. Bonds to the amount of $60,000 will be issued to cover the cost of the plant. C. B. Woodbury is city clerk.

GLENDORA, CAL.—The Glendora Irrigating Company has awarded a contract to the Westinghouse Electric & Manufacturing Company for a 100-kw generator and a 75-hp motor for its new plant.

GLENDORA, CAL.—Arrangements have been completed by the Glendora Light & Power Company for extending its transmission lines to the W. B. Glidden neighborhood, two miles distant, which will cost about $2,500.

MONTEREY, CAL.—H. R. O'Bryan has applied to the Board of Supervisors for a franchise to construct an electric railway in Monterey County.

NEVADA CITY, CAL.—A double-cylinder eight-drill giant air compressor has recently been installed at the Pittsburgh mine of the Pittsburgh Consolidated Gold Mining Company. The compressor will be operated by water power until the electric equipment arrives and the transmission line completed to the mine, when the entire equipment of the mine will be operated by electrical power. M. B. Kerr is manager of the mining company.

PASO ROBLES, CAL.—Plans are being prepared by C. E. Moore, of Santa Clara, Cal., for a municipal electric light plant.

RED BLUFF, CAL.—Plans are being made by the E. Clemens Horst Company to install an additional 150-hp motor for irrigation purposes.

REDDING, CAL.—The Sacramento Valley Power Company has purchased extensive water rights in North Battle Creek in Shasta County, which will be utilized for developing electrical power. The Sacramento Valley Power Company will develop the water power, increasing the output of its plant from 3600 to 15,000 hp.

SAN FRANCISCO, CAL.—The properties of the Tuolumne Water Power Company and the Stanislaus Electric Power Company were sold at auction in Sonora, May 10, to the United Railways Investment Company of New Jersey, the holding company for the United Railroads of San Francisco. It is proposed to organize a new company, which will issue bonds to enable it to complete the work of development and construction of the properties, which extend only as far as Mission San José.

SANTA BARBARA, CAL.—The City Council has granted the Pacific Improvement Company a franchise to operate a trackless trolley system from Santa Barbara to the Hope ranch.

DENVER, COL.—It is reported that plans are being made by the Colorado Power Company for extensive additions to its system, which will involve an expenditure of nearly $3,000,000. It is proposed to push work on the Gore Canyon plant, and the smaller plants, which will ultimately furnish 100,000 hp. The company expects to furnish electricity from the Shoshone plant in Denver early in June.

BRIDGEPORT, CONN.—It is reported that the United Illuminating Company has awarded a contract for the construction of a brick power house.

MIDDLETOWN, CONN.—The City Council has entered into a contract with the Middletown Electric Light Company under the terms of which the city is to pay $89.50 per arc lamp per year.

HAVANA, CUBA.—The Automatic Electric Company, of Chicago, Ill., has been awarded the contract for changing over the manual switchboard telephone system to the automatic system in all of the important cities in Cuba. The contract provides that at least 6000 automatic telephones shall be placed in the city of Havana not later than Sept. 1, 1909.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 26 for furnishing one 1000-kw and two 1500-kw turbo-alternators for the navy yards, New York, Philadelphia and Boston. Specifications can be obtained on application to the bureau or to the commandant of the navy yards named. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 26, for furnishing and installing piping, pumps, condensers, heaters, etc., in the central power plant, at the navy yard, Puget Sound, Wash. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard. R. C. Hollyday is chief of bureau.

JACKSONVILLE, FLA.—Arrangements are being made by D. G. Zeigler for the organization of a construction company for the purpose of constructing and equipping water powers in the South. It is understood that the company will have its headquarters in Jacksonville, Fla., and will make a specialty of developing hydro-electric plants and will take securities in payment of construction work. The company is to be capitalized at $1,000,000.

JASPER, FLA.—D. G. Zeigler & Company, consulting engineers, of Jacksonville, Fla., have been retained as consulting engineers for the development of a hydro-electric plant on the Allappaha River, seven miles from Jasper, Fla., and 18 miles from Valdosta, Ga.; Quitman, Ga.; Lake Park, Ga., and Statesville, Ga., all of which will be furnished with electricity from the plant, which it is expected will develop 10,000 hp.

LEESBURG, FLA.—The Town Council has granted a 30-year franchise to J. Y. Clark to install an electric light plant and water works system. It is said that Mr. Clark will commence work at once on construction of the plants so as to have them in operation by next winter.

ST. AUGUSTINE, FLA.—The City Council is considering the question of issuing bonds to the amount of $8,000 for electric lighting.

COLLEGE PARK, GA.—The City Council has granted the Fairburn & Atlanta Railway & Electric Company a franchise to construct an electric railway in College Park. The company proposes to build an electric railway from Fairburn through Stonewall and Red Oak to College Park, 11 miles in length.

FITZGERALD, GA.—The Fitzgerald & Ocilla Electric Railway Company has filed a mortgage in favor of the Windsor Trust Company, of New York, N. Y., to secure an issue of $250,000 in bonds. The company proposes to construct an electric interurban railway connecting Fitzgerald and Ocilla, 12 miles in length.

LAWRENCEVILLE, GA.—J. T. Holbrook, superintendent of the municipal electric light plant, has recommended that the electric light plant be enlarged. The improvements will include the installation of a 125-hp engine direct connected to an 80-kw, 2300-volt, three-phase generator, with necessary accessories; also one 70-hp boiler with heater, etc., and also to extend the transmission lines to other parts of the city.

HONOLULU, HAWAII.—Plans are being considered by the Honolulu Rapid Transit & Land Company for the construction of a five-mile extension between Honolulu and Pearl Harbor.

PAYETTE, IDAHO.—The Idaho-Oregon Light & Power Company is now ready to furnish electricity in Payette. It is said that the company will extend its transmission lines to Payette Heights, to furnish electricity for lamps and motors and for irrigation purposes in that section.

KENDRICK, IDAHO.—The Council has granted a franchise to C. B., H. M. and A. N. Richards for the construction and operation of an electric light plant in Kendrick.

WALLACE, IDAHO.—The capital stock of the North Idaho Telephone Company has been increased from $25,000 to $100,000.

CHICAGO, ILL.—The Chicago, Wheaton & Western Railway Company has awarded the contract for the section of its proposed electric railway from Wheaton to Geneva to W. C. Carrington, Gary, Ind. Henry C. Wood is president of the company.

GALENA, ILL.—The Interstate Light & Power Company, recently incorporated, has acquired the properties and franchises of the Tri-State Light & Power Company, of Galena, Ill., and Platteville Electric Light & Power Company, of Platteville, Wis. The new company will make improvements to the plant, contracts for which are now being awarded. It will furnish electricity for lamps, motors and mines in Galena, Ill.; Platteville, Hazel Green, Cuba City and Benton, Wis. The officers of the company are A. O. Fox, of Madison, Wis., president; George B. Caldwell, of Chicago, Ill., vice-president; Morris F. Fox, of Madison, Wis., secretary; L. A. Caldwell, of Galena, Ill., treasurer; H. M. Byllesby & Company, of Chicago, Ill., consulting engineers, and J. A. Stewart, Galena, Ill., superintendent.

JOLIET, ILL.—Mayor Cronin has recommended that all electric wires be placed underground in the business section of the city.

PEORIA, ILL.—Application has been made to the City Council by W. T. Irwin, president of the Peoria Railway Terminal Company, for a franchise to construct and operate a passenger and freight railway along South Washington Street.

PULLMAN, ILL.—Plans are being made by the Pullman Company for extensive improvements and extensions to its plant at Pullman, which will involve an expenditure of about $3,000,000, and include the installation of an 8000-hp electric power plant, at a cost of $100,000, to furnish electricity for motors for the shops.

ROCK ISLAND, ILL.—The Galesburg & Rock Island Traction Company has announced that work on the construction of its proposed electric railway will be under way at four different points by July 1. The railway will extend from Galesburg to Alexis, thence to Preemption; from Preemption to Milan, and thence to Rock Island. Cars will be operated into Rock Island from Milan over the tracks of the Tri-City Railway. The cost of the road is estimated at $2,000,000.

CLERMONT, IND.—The Board of Trustees will make improvements to the Indiana Girls' School, for which an appropriation was made by the last General Assembly, which will include improvements to the power plant and for lighting the grounds. Bids will soon be asked for the proposed work.

EVANSVILLE, IND.—The Hercules Buggy Company is reported to be installing an electric power plant with an output of 500 hp to supply electricity for operating all four of its industrial plants. A new power house is being erected, which will be equipped with a water-tube boiler and a Corliss engine. Electricity will be distributed to the different departments to operate motor-driven machinery.

INDIANAPOLIS, IND.—The National Coning Machinery Company, recently incorporated with a capital stock of $1,000,000, proposes to construct a plant at a cost of about $500,000 to be equipped with both steam and electrical machinery. The directors are William A. Scott, Alfred C. Wood and Malon P. Woody.

MARION, IND.—The Western Motor Company is preparing to erect a large plant in this city. The company will equip the plant with electrically driven machinery and will manufacture motors of all kinds. J. L., A. C. and Charles Barley and J. W. Stevenson, all of Marion, are interested in the enterprise.

MISHAWAKA, IND.—Joseph Colbert, M. E. Robbins and Edward Went are members of a committee appointed to co-operate with the light committee of the Business Men's Association in the project to secure a new lighting system for the city.

PLYMOUTH, IND.—The City Council has awarded the Plymouth electric light plant a 10-year franchise and a contract for lighting the city for a term of five years. C. D. Snoeberger is president and treasurer.

WESTVILLE, IND.—The La Porte Electric Company has been granted a franchise to furnish electricity in Westville, under which it agrees to extend its transmission line to the town as soon as 60 subscribers are secured. The proposed line will be erected by the way of Pinola and Pinhook, a distance of about 12 miles. The company will also furnish electricity to residents along the line.

BETTENDORF (P. O. DAVENPORT), IA.—A proposition has been submitted to the Council by the Bettendorf Car Company offering to install a water and light system in the town.

BOONE, IA.—It is reported that E. G. Pratt, president of the Boone Gas Company, has secured an option on the property of the Boone Electric Company, the Boone Suburban Railway Company and the Central heating plant. It is said that Mr. Pratt proposes to ask the Council for a suitable franchise to combine the systems. Plans are being considered for extensive improvements to both the electric plant and street railway which will involve an expenditure of about $200,000. John Reynolds is president and general manager of both the Boone Electric Company and the Boone Suburban Railway Company.

COUNCIL BLUFFS, IA.—It is said that plans have been completed and that contracts will soon be awarded for the new substation of the Citizens' Gas & Electric Company on First Avenue at a cost of from $7,000 to $10,000. The equipment will be entirely new, with the exception of eight transformers, which will be removed from the present substation.

DES MOINES, IA.—The Des Moines Electric Company is advertising for bids for the construction of a new power plant to be located on the river front. The present power house is to be torn down and the new building erected on the same site. The new station will be 135 ft. x 62 ft. and will have two stories and basement. A smokestack 200 ft. high and 16 ft. in diameter will be erected. Contracts have already been awarded for a 1950-kw steam turbine and for boilers of same capacity. The cost of the plant with equipment is estimated at $200,000. The output of the plant will be increased by 65 per cent. It is expected to have the plant completed by Nov. 1. Paul B. Sawyer is general manager of the company.

FORT LEAVENWORTH, KAN.—Bids will be received until June 15 by Major Thomas H. Slavens, constructing quartermaster, U. S. Military prison, Fort Leavenworth, Kan., for furnishing building material for power house and furnishing and installing machinery for power plant at U. S. military prison Fort Leavenworth, Kan. Plans and specifications will be furnished by the above office upon a deposit of $10, which will be refunded when same are returned, or they may be seen at the following offices: Depot Quartermaster, Omaha, Neb.; Depot Quartermaster, St. Louis, Mo.; Depot Quartermaster, New York, N. Y., and Chief Quartermaster, Chicago, Ill.

HALSTEAD, KAN.—Bids will be received by J. D. Lange, City Clerk, until May 28 for furnishing material for a water works system, including power house machinery, two 200-gal. per minute, triplex power pumps and for two 25-hp gas engines. Plans and specifications can be seen at the office of the city clerk, Halstead, and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas City, Mo. Plans can be secured upon application to the engineers upon payment of five dollars.

ST. JOHN, KAN.—The City Council is considering the question of installing an electric light plant and water works system in St. John, for which plans have been prepared. Burns & McDonnell, of Kansas City, Mo., are the engineers.

PADUCAH, KY.—We are informed that the Kentucky & Ohio River Interurban Railroad Company contemplates commencing work on the construction of its proposed electric railway connecting Paducah and Cairo, Ill., about June 1. The railway will be about 35 miles in length.

NEW ORLEANS, LA.—Arrangements are being made by the New Orleans Railway & Light Company for the extension of the Clio Street line from Napoleon Avenue to the Protection Levee, a distance of about three miles. Application for a franchise will be made at the next meeting of the City Council.

NEW ORLEANS, LA.—Bids will be received by the Court House Commission until June 15 for the installation of electric fixtures in Court House, New Orleans. Plans and specifications are on file in the office of the commission and at the office of P. Thornton Marye, architect, Candler Building, Atlanta, Ga.

NEW ORLEANS, LA.—It is reported that the directors of the New Orleans Railway & Light Company have decided to issue $50,000,000 in bonds, of which $30,000,000 will be held in the treasury to provide for the retirement of $30,000,000 4½ per cent bonds now outstanding and the remaining $20,000,000 will be issued from time to time, as required, exclusively for extensions and betterments and the purchase of new equipment, and for the payment of $1,266,000 debenture notes as they become due.

RUMFORD, MAINE.—The Rumford Falls Power Company has awarded the contract for completing excavations, foundations, stone and concrete masonry, brick station, etc., in connection with the hydro-electric development project at Rumford Falls started last year, to the H. P. Cummings Construction Company, of Ware, Mass. Charles A. Mixer is engineer of the Rumford Falls Power Company.

HAGERSTOWN, MD.—The Street Commissioners have awarded the contract for new machinery for the municipal electric light plant to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for $25,000. The new equipment will double the output of the plant.

ATHOL, MASS.—The plant and holdings of the Athol Gas & Electric Company have been purchased by W. G. Webber, of Marlboro. The new company will retain the present office in Athol. It is expected that the plant will be improved. W. G. Webber is president of the new company and W. D. Smith, vice-president.

BOSTON, MASS.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 26, for furnishing and installing piping in the central power plant, navy yard, Boston, Mass. The cost of the work is estimated at $7,000. Plans and specifications can be obtained on application to the bureau or the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

BROCKTON, MASS.—The Selectmen have granted the Edison Electric Illuminating Company permission to take over the property of the Stoughton Gas & Electric Company, and have also granted the company a new franchise. Under the terms of the franchise the company agrees to reduce the price of electricity for lamps from 20 to 15 cents per kw-hour and to give all consumers of electricity for lamps and motors the same rates as allowed in Brockton. The company assumes the street lighting contract and agrees to maintain the service for the fire-alarm whistle.

HARDWICK, MASS.—The Selectmen have made arrangements with the Ware Electric Company to run two more wires from Gilbertville to Hardwick Center to furnish electricity in the town. The town is to purchase the transformer.

HAVERHILL, MASS.—The New Hampshire Electric Railways Company has awarded the contract for the construction of a sub-station in Methuen to E. A. Peabody & Son, of Lawrence, Mass. The station is located on the line of the Lawrence & Methuen line, and will furnish electricity for the western division.

LEE, MASS.—The Lee Electric Company is extending its transmission lines to Lenoxdale for the purpose of furnishing electricity for lighting the village. Twenty-two tungsten lamps will be required.

LYNNFIELD, MASS.—It is expected that the town will soon have an electric lighting system, as the municipal light board has secured the number of contracts demanded by the managers of the Reading municipal electric light plant before extending transmission lines to Lynnfield.

ORANGE, MASS.—Plans are being made for extensive improvements on the Orange Electric Light Company's plant. The present plans call for the construction of a new dam and power house at Wendell Depot.

UPTON, MASS.—The Upton Electric Light Company has submitted a proposition to the Selectmen for lighting the streets of the town. The company agrees to establish a street lighting system and furnish street lamps on a three-year contract as follows: On a moonlight schedule, the

lamps to burn until midnight, 60-cp incandescent lamps at $16.50 each per year; 40-cp lamps, at $14.50 each, and for 32-cp $13.50 per lamp per year. An appropriation of $1,650 a year is recommended for lighting the town. The Selectmen have been authorized to light the town by electricity, instead of kerosene.

WARE, MASS.—Preparations are being made by the George H. Gilbert Manufacturing Company for operating its No. 1 and No. 2 mills by electricity instead of steam power as at present. Electricity will be supplied from the electric power plant at No. 4 mill.

WHITMAN, MASS.—Announcement has been made by the Edison Electric Illuminating Company of Brockton that the price for electricity for lamps will be reduced from 20 to 15 cents per kw-hour for residential and commercial lighting.

MINNEAPOLIS, MINN.—Orders have been placed by the Minneapolis General Electric Company for two 1000-kw rotary converters, at a cost of $76,000.

MIZPAH, MINN.—William Potter is reported to have been granted a 15-year franchise by the Village Council to install an electric light and power system in Mizpah.

CAPE GIRARDEAU, MO.—Contracts have recently been awarded by the Cape Girardeau-Jackson Interurban Railway Company for equipment for its power house as follows: For switchboard instruments, to the Western Electric Company, and for switches and circuit breakers to the Westinghouse Electric & Manufacturing Company.

EL DORADO SPRINGS, MO.—B. F. Proctor, who was recently granted a franchise to install an electric light system in El Dorado Springs, is now erecting a plant in this town.

SEDALIA, MO.—Only one bid was submitted for street lighting, which was rejected by the City Council. The bid was submitted by the Sedalia Light & Traction Company for a term of 10 years at the rate of $67.50 per lamp per year. The City Council has adopted a resolution authorizing the city counselor to prepare an ordinance providing for the construction of a municipal electric light plant; also authorizing the Mayor to call a special election to vote on a bond issue not to exceed $150,000 for the construction of the plant.

BROKEN BOW, NEB.—J. W. Earley, of Columbus, is reported to have been granted a franchise by the Council to install an electric light and power plant. The plant is to be equipped with new machinery and will have an output of 100 kw.

WEEHAWKEN, N. J.—The Weehawken Contracting Company contemplates installing a new two-phase power circuit and a block transformer service. James B. Ryan is secretary and manager.

CLOVIS, N. M.—Sealed proposals will be received at the office of E. J. Feagan, city clerk, until June 16, for furnishing material and labor and constructing complete water works, electric light and sewer systems for the City of Clovis; separate bids will be received as follows: 1—For furnishing cast iron pipe and special castings. 2—For material and constructing steel tower and tank having a capacity of 100,000 gal. at an elevation of 125 ft. 3—For four motor-driven, deep-well pumping machinery units. 4—For electrical equipment, including generators, switchboard, lighting equipment, etc. 5—For furnishing material and constructing chimney. 6—For drilling two wells 500 ft. deep; material for casting to be furnished by the city. 7—For furnishing certain materials not above mentioned, consisting of three 66 in. x 16 ft. boilers, boiler feed pumps, two high-grade engines, hydrants and valves, poles, wire, power house materials, etc., and constructing water works and electric lighting systems complete, ready for operation. All materials to be furnished f. o. b. in Clovis. Plans and specifications on file at the office of the city clerk, Clovis, and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas City, Mo. Parties desiring plans for personal use may secure same on application to the engineers and payment of $10 to cover cost of the prints, or for $5 for either set of plans.

ALBANY, N. Y.—Bids will be received until June 9 by the State Commission in Lunacy at the Capitol, Albany, N. Y., for installing an outside lighting system at the Middletown State Hospital, Middletown, N. Y. Drawings and specifications may be seen at the hospital or may be obtained from Franklin B. Ware, state architect, Albany, N. Y.

AMITYVILLE, N. Y.—The Amityville Electric Light Company has been granted permission by the Public Service Commission, Second District, to execute a mortgage of $20,000 to secure an issue of $15,000 in bonds, the proceeds of $3,000 to be used to refund an outstanding issue of $3,000, and $3,000 for improvements to its plant. Thomas E. Byrne is general manager of the company.

BATAVIA, N. Y.—Judge Holt, of the United States Circuit Court at Rochester, N. Y., has authorized the sale of the plant and holdings of the Geneva County Electric Light, Power & Gas Company to be sold on June 17 and the proceeds of the sale distributed among the creditors. The plant furnished electricity generated at Niagara Falls in Batavia. Marc W. Comstock, of Buffalo, N. Y., is receiver of the company.

BROOKLYN, N. Y.—The contract for installing electric equipment in new Public School No. 164, Borough of Brooklyn, has been awarded to Cowden & De Young, 237 Broadway, New York, N. Y., for $10,239. C. B. J. Snyder is superintendent of school buildings.

BROOKLYN, N. Y.—The Kings County Lighting Company has applied to the Public Service Commission for an approval of a proposed issue of $450,000 in bonds, the proceeds to be applied to the retirement of $250,000 5 per cent bonds falling due Jan. 1, 1910, and the remaining $200,000 for acquiring property and making improvements to its plant.

BROOKLYN, N. Y.—The Court of Appeals handed down a decision in favor of the Brooklyn Rapid Transit Company in the matter of the proposed extension of the Nostrand Avenue line from Nostrand Avenue and Flatbush Avenue and Nostrand Avenue to Avenue Q, a distance of about 1½ miles. The company will commence work at once on the extension.

BROOKLYN, N. Y.—Bids will be received until June 1 by C. B. J. Snyder, superintendent of school buildings, Department of Education, New York, N. Y., for installing electric equipment in addition to and alterations in Public School, No. 84, on Glenmore Avenue, Borough of Brooklyn. Blank forms and estimates and specifications may be obtained at the office of the superintendent, Park Avenue and Fifty-ninth Street, New York, N. Y., and also at branch office, 131 Livingston Street, Borough of Brooklyn.

BUFFALO, N. Y.—It is reported that the Economic Power & Construction Company will renew its application to the City Council for a franchise to supply electricity and steam heat in Buffalo. Herbert P. Bissell is interested in the enterprise.

BUFFALO, N. Y.—Bids will be received until June 2 at the office of public works, City Hall, Buffalo, for the construction of underground conduits for the Police and Fire Department wires in the districts wherein all overhead wires are to be placed underground. Plans and specifications can be seen and blank forms of proposals secured on application to the Bureau of Engineering. Francis G. Ward is commissioner.

FORT HAMILTON, N. Y.—Bids will be received at the office of the Constructing Quartermaster, Fort Hamilton, N. Y., until June 15 for material and labor required for the construction of an electric lighting system and substation at Fort Hamilton. Plans and specifications can be seen at the office of the Chief Quartermaster, Department of the East, Governors Island, N. Y., or at the above office. A deposit of $10 will be required on all plans sent out from the office, which will be refunded upon the return of the same.

GENEVA, N. Y.—The Economic Power & Construction Company, it is said, will apply to the City Council for a franchise to furnish electricity in Geneva.

ILION, N. Y.—Plans are being made by the Clarke & Baker Company to erect a new building in Ilion for cabinet work, which it is said will be operated by electricity. The company will require a number of motors, but definite plans have not yet been decided upon.

LESTERSHIRE, N. Y.—H. B. Sweet, Clarendon Building, Utica, N. Y., consulting engineer, has been engaged to prepare preliminary plans and estimates for the construction of a municipal electric light plant in Lestershire.

NEWBURGH, N. Y.—The Public Service Commission, Second District, has authorized the Newburgh Light, Heat & Power Company to issue $18,000 in debenture bonds, the proceeds to be used for the construction of a transmission line to supply electricity to the Ashokan Aqueduct contractors.

NEW YORK, N. Y.—Announcement has been made by the Hudson & Manhattan Railroad Company that it proposes to construct 12 miles of single track during the present year.

NEW YORK, N. Y.—The Interborough Rapid Transit Company contemplates enlarging its power plant, but as yet has not definitely decided upon the equipment to be purchased.

NEW YORK, N. Y.—The Public Service Commission has granted the United Electric Light & Power Company permission to put into effect a revised tariff showing a proposed reduction of from 10 to 25 per cent in the charges for tungsten lamps.

NEW YORK, N. Y.—Bids will be received at the office of the Armory Board, Hall of Records, New York, N. Y., until June 2, for the installation of an electric elevator in the armory of the Sixty-ninth Regiment, Lexington Avenue and Twenty-first Street, New York City.

NEW YORK, N. Y.—The Long Island Railroad Company has awarded the contract for the construction of its proposed electric railway between Melville and Amityville, a distance of nine miles, to the Seaboard Construction Company, of Brooklyn, N. Y.

NEW YORK, N. Y.—Sealed proposals will be received until June 3 by J. W. Stevenson, commissioner of bridges, 21 Park Row, New York, N. Y., for constructing the railings, stairways, etc., roadway and footwalk pavements, track and electrical equipments of the Manhattan bridge. Blank forms and specifications may be obtained at the above office.

NEW YORK, N. Y.—Bids will be received by John W. Brannan, president of the Board of Trustees, Bellevue and Allied Hospitals, Twenty-ninth Street and First Avenue, New York, N. Y., until June 1, for electric lamps, to be delivered on or before Dec. 31, 1909. Blank forms may be obtained at the office of the contract clerk, 419 East Twenty-sixth Street, New York, N. Y., where bids and deposits are to be delivered.

NEW YORK, N. Y.—Bids will be received until June 1 by C. B. J. Snyder, superintendent school buildings, Department of Education, for installing electric equipment in the additions to and alterations in Public School No. 84, on Glenmore Avenue, Borough of Brooklyn, N. Y. Also installing electric equipment in additions to and alterations in Public School No. 14, Stapleton, and Public School No. 18, West New Brighton, Borough of Richmond.

PORT JERVIS, N. Y.—The Common Council has granted the Port Jervis & Delaware Valley Railroad Company a franchise in Port Jervis. F. A. Sawyer is president of the company.

SENECA FALLS, N. Y.—The Geneva, Waterloo & Cayuga Lake Traction Company, it is said, contemplates the construction of an auxiliary power plant at Cayuga Lake Park, N. Y. The equipment will include a 200-kw generator and a 200-hp Ball engine. W. C. Gray, of Seneca Falls, is manager.

SYRACUSE, N. Y.—The Syracuse Lighting Company has applied to the Public Service Commission, Second District, for permission to execute a mortgage for $2,500,000 to secure an equal amount of bonds, of which $207,000 will be expended immediately for improvements and extensions to its system. The company proposes to expend $160,000 for extensions to its gas and electric service to districts not now supplied, and $47,000 for improvements to its electric power station and in laying high-pressure gas mains. J. C. De Long is general manager.

THERSEA, N. Y.—Negotiations have been completed by the Thersea Hydro-Electric Power Company for taking over the James Wakefield property, which includes a water privilege. The company is making improvements to its plant, which it expects to have completed early in July.

WEST SENECA, N. Y.—The Town Board has granted the Great Lakes Security Company a franchise to lay conduits and erect transmission lines for the distribution of electricity in West Seneca for a term of 59 years. The company is said to be a holding company for the Buffalo General Electric Company.

HICKORY, N. C.—It is announced that one of the largest cotton mills in the world will be built in Hickory when the proposed water power development on the Catawba River at this place is completed. Col. M. E. Thornton is at the head of the water power development.

ANTWERP, OHIO.—A. A. Painter, owner of the local electric light plant, is planning to install a 75-kw, 60-cycle, three-phase alternator, and also in the near future expects to make further additions to the plant, which will include the installation of a 150-hp boiler, a 125-hp engine and 100-kw, three-phase generator to furnish electricity for day service.

CLEVELAND, OHIO.—The Cleveland, Alliance & Mahoning Valley Railroad Company is reported to be making arrangements to begin work immediately on its proposed electric railway. The company has taken over a steam railroad between Ravenna and Hudson, which it will equip to be operated by electricity, and will also extend it from Hudson to Cleveland by the way of Twinsburg, Randall and Woodland Hills. The railroad between Ravenna and Warren has been purchased by the company, which will also be equipped to be operated by electricity at once. The main offices of the company are located in the Electric Building, Cleveland, Ohio.

DAYTON, OHIO.—The Board of Education has accepted the proposition of the Dayton Light Company to install a power plant at the Manual Training School.

EATON, OHIO.—The new Eaton Electric Light Company has submitted another proposition to the Town Council for consideration. It is said that the price for street lamps is $21.50 each per year, the same rate that is now paid. The company will also establish a day service. If a 10-year contract is granted the company it will rebuild its plant at a cost of from $15,000 to $20,000. Judge Elam Fisher represented the company before the Council.

FOSTORIA, OHIO.—The electric light franchise and contracts of the City Heat & Light Company were sold by the receivers May 12 to Charles Ash, president of the Commercial Bank, for $53,126, and the large gas plant, dismantled, to the Consolidated Railways & Light Company for $10,000. The street lighting contract still has eight years more to run.

GALLIPOLIS, OHIO.—The Kanauga Traction Company, which has been operating a five-mile gasoline motor railway between Gallipolis and Kanauga, is now equipping the railway to be operated by electricity. The company also contemplates making extensions to the road during the summer. J. S. Howard is secretary and treasurer.

NORTH BEND, OHIO.—Bids will be received by Thomas Hynes, village clerk, until June 14, for furnishing electricity for lighting the streets and public places for a term of ten years, in accordance with plans and specifications now on file in the office of the village clerk.

WARREN, OHIO.—The Peerless Electric Company has transferred all its holdings in Newton and Warren Townships, including land, water rights, power plants and transmission lines and a franchise in the city of Warren, to the Hydro-Electric & Gas Company. The last named company has been granted a franchise in Niles to furnish electricity to operate the municipal electric light plant. Work will commence immediately on construction of the transmission lines to Niles.

CHICKASHA, OKLA.—We are informed that the Chickasha Light, Heat & Power Company will commence work within three weeks on the reconstruction of its plant. The company is in the market for boilers, steam turbines, generators, condensing apparatus, pole line material, switchboards, material for brick building, etc. A 2300-volt, 60-cycle, three-phase system will be installed. C. G. Johnson is superintendent of the work, and C. L. Whedon is manager of the company.

RYAN, OKLA.—The citizens are considering the question of installing an electric light plant, water works and sewer systems, at a cost of from $45,000 to $69,000, which will soon be submitted to a vote of the people.

TEXHOMA, OKLA.—Investigations are being made by G. D. Sturdevant, of Kansas City, Mo., with a view of securing a franchise for the installation of an electric light plant and water works system.

PORTLAND, ORE.—Plans are being made by the Portland Railway, Light & Power Company for extensions to its railway system, which will require the construction of seven miles of new track.

PANAMA.—An agreement has been made between the Isthmian Canal Commission and the Panama Railroad Company, under which the railroad company will construct and operate all telegraph and telephone lines and equipment that may be needed by the company and the commission. The commission agrees to pay the company $7.50 per month for each telephone instrument and $2,400 per month for all services rendered by the company in maintaining operators, signalmen and other employees made necessary by the operation of the canal commission's trains over the company's tracks.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until June 14, for furnishing the following supplies: Centrifugal pump and engine, portable rock crusher plant with elevator, motor car, gasoline motors, transformers, speed changing device, motor driven trolley, electric hoist, etc. Blanks and general information relating to this circular (No. 512) may be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 316 Hibernia Bank Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

GETTYSBURG, PA.—The Keystone Electric Light, Heat & Power Company contemplates making extensions to its plant, which will include the purchase of one 125 or 150-kw, single-phase, 200-volt, 60-cycle generator. T. P. Turner is general manager.

HAZLETON, PA.—It is reported that it is proposed to form companies in Black Creek, Foster, Sugarloaf, Nescopeck and Butler Townships, all within a radius of 12 miles of Hazleton, for the purpose of furnishing electricity for lamps and motors in those towns. Electricity for operating the different systems will be obtained from the plant of the Harwood Company, now under construction at Harwood. Calvin Pardee, of Philadelphia, Pa., president of the Harwood Company, and others are interested in the enterprise.

PITTSBURGH, PA.—A special meeting of the stockholders of the Philadelphia Company will be held July 22 to vote on the question of increasing the capital stock of the company from $42,000,000 to $47,000,000. It is stated that a large part of the proceeds will be advanced to the Pittsburgh Railway Company and the Allegheny County Light Company for extensions and improvements.

SLATINGTON, PA.—Bids will be received by A. N. Kennel, borough clerk, until June 15 for lighting the streets of the city for a term of five years from Jan. 1, 1910, with either gas or electricity. Specifications for electric lighting may be seen at the office of the borough secretary.

LAMAR, S. C.—The proposition to issue $5,000 in bonds for the construction of an electric light plant will be submitted to the vote of the people.

CHATTANOOGA, TENN.—S. W. Devine has applied to the City Council for a franchise to construct and operate a street railway in Chattanooga.

JOHNSON CITY, TENN.—Contracts will be awarded by the Johnson City Traction Company in the near future for the construction of an extension to its system, 1½ miles in length.

LEBANON, TENN.—Plans have been completed for the construction and equipment of the plant of the Lebanon Woolen Mills Company, which will be operated by electric power.

EL PASO, TEX.—The El Paso Electric Railway Company has commenced work on the construction of the extension of its power plant, located on South Santa Fe Street. Additional equipment to be installed will include a 1500-kw, horizontal, Allis-Chalmers turbine engine, direct connected to a 2200-volt, two-phase generator, with a new switchboard gallery, traveling crane, boiler plant and condensing apparatus. The Stone & Webster Corporation, of Boston, Mass., has charge of the work.

GALVESTON, TEX.—Plans and specifications have been prepared by W. D. Masterson, superintendent of electrical department, for increasing the output of the municipal electric light plant, which includes the installation of an engine and generator and erection of 300 arc lamps, together with rectifiers, transformers and switchboards.

PALACIOUS, TEX.—A. C. Randolph, who holds a 50-year franchise, is planning to install an electric light plant with sufficient output to supply 1500 16-cp lamps, at a cost of $10,000.

LOGAN, UTAH.—The Board of Trustees of the Utah Agricultural College has decided to erect an electric light plant at the college at a cost of about $20,000. Lorenzo M. Stohl, of Salt Lake City, Utah, is president.

BROOKNEAL, VA.—Surveys are being made for the construction of a dam to be built across Staunton River for the development of water power to be utilized to generate electricity. E. R. Monroe is reported to be interested in the project.

LYNCHBURG, VA.—Plans are being made by the People's Improvement Company to commence work on the construction of its proposed electric railway connecting Fairview Heights and Lynchburg, a distance of one mile, about June 1. The company will be in the market for rails, ties, poles and overhead material. When completed the road will be operated as part of the Lynchburg Traction & Light Company's system. R. J. Hughes, of Lynchburg, Va., is president of the company.

MARTINSVILLE, VA.—Plans are being made to establish a $300,000 cotton mill in Martinsville, one-sixth of the capital stock to be taken by local people and the rest by the promoters of the enterprise. It is proposed to utilize the Reynolds factory on Franklin Street. An option has been taken on 500 hp of electrical power. It is expected to have the mill in operation by Jan. 1, 1910.

NORTON, VA.—The city is reported to be prepared to grant a franchise for an electric light plant.

RICHMOND, VA.—Mayor Richardson has vetoed the ordinance awarding the contracts for equipment for the municipal electric light plant, on the ground of its irregularity.

RICHMOND, VA.—The Jamestown Portland Cement Company, incorporated, with a capital stock of $2,400,000, proposes to erect a large cement plant on the James River, about 10 miles above Newport News. The American Cement Engineering Company, of New York, N. Y., has the contract for the construction of the plant, which will include the installation of a 4000-hp power plant. It is expected that the construction company will award contracts for machinery, which will include electrical equipment, steam shovels, elevating and conveying machinery, etc., before Sept. 1.

CHEHALIS, WASH.—The North Coast Railroad Company has filed notice of appropriation of two water rights of the Cowlitz River. One of which calls for 500 cu. ft. of water per second from Ohanapecosh or the main fork of the Cowlitz River, the water to be carried a distance of six and one-quarter miles to Lake Frederick, where a power station will be erected. The second appropriation is from Muddy Fork of the Cowlitz, and calls for 500 cu. ft. of water per second, which will also be carried to Lake Frederick, a distance of four and one-quarter miles. The water will be utilized to generate electricity, which will be distributed in Lewis, Pierce, Kittitas, Yakima and King counties.

COLVILLE, WASH.—The Stevens Power & Light Company, successors to the Northwestern Light & Power Company, contemplates increasing the output of its plant by 600 kw. The company also furnishes electricity in Meyers Falls and Kettle Falls. The officers of the company are: A. H. Sperry, of Spokane, Wash., president; H. R. W. Williams, of Colville, vice president and manager; E. B. Bird, of Spokane, secretary and treasurer.

EVERETT, WASH.—J. A. Soderburg, proprietor of the Index Granite Works, has made arrangements with the owners of the water rights at Sunset Falls to construct a hydro-electric plant at the falls, work on which will commence in a few weeks. It is estimated that at least 7000 hp can be developed.

NORTH YAKIMA, WASH.—A. N. Mougan, of Seattle, Wash., is reported to be interested in a project to establish an electric power plant on the Yakima River, near this city, where, it is said, 10,000 hp will be developed.

PULLMAN, WASH.—Plans and specifications for extensions to the heating and lighting plant of the State College are now under consideration by the trustees of the college. The cost of the work is estimated at $50,600, and will include the construction of an extension 66 ft. x 110 ft., which will be used for an engine and boiler room. A smokestack 150 ft. high will be erected.

SEATTLE, WASH.—Plans have been submitted to the City Council for the expenditure of the $535,000 available for extensions to the municipal electric light plant from the $800,000 bond issue. J. D. Ross, electrical engineer, recommends an expenditure of $250,000 toward the construction of the new dam; for new street lamps, $150,000, and $135,000 for extensions to the commercial lighting service. L. B. Young is superintendent of the plant.

SPIRIT LAKE, WASH.—A decision handed down by Judge Sanford has awarded water rights for Spirit Lake and the middle branch of the Toutle River to the St. Helens Mill & Power Company, of St. Helens, Ore. The company proposes to erect a power plant, sawmills and other industries in the St. Helens district and Skamania County, which will involve an expenditure of about $1,000,000.

EAU CLAIRE, WIS.—It is reported that the Dells Paper & Pulp Company contemplates the construction of a new plant at Jim Falls, which will include a hydro-electric development. The company recently purchased a 300-hp induction motor for its plant in Eau Claire.

GRAND RAPIDS, WIS.—The Council has granted the Grand Rapids Street Railroad Company a franchise to construct a street railway in Grand Rapids. The company proposes to construct an electric railway between Grand Rapids and Neskoosa, a distance of seven miles. Neal Brown, of Wausau, is president.

MENOMONIE, WIS.—The Chippewa Valley Railway, Light & Power Company has entered into a contract with Red Wing Gas, Light & Power Company, of Red Wing, Minn., to furnish electricity from its plant in Menomonie for lamps and motors in Red Wing.

RHINELANDER, WIS.—The contract for the construction of the large dam, flumes, foundation of power house and excavation of a tail race in the Wisconsin River at Rothschild, has been awarded to George M. Painter, of Chicago, Ill.

FORT YELLOWSTONE, WYO.—Bids will be received until June 12 by Lieut. G. C. Smith, constructing quartermaster, U. S. A., Fort Yellowstone, for the construction of a reinforced concrete reservoir for the hydro-electric power plant at this post. Specifications, blank proposals and further information furnished on application.

CAMROSE, ALTA., CAN.—The Board of Trade is willing to offer inducements to anyone who will establish an electric light and power plant in Camrose. For further information address R. L. Rushton.

EDMONTON, ALB., CAN.—The City Council has awarded the contract for structural steel work for the new power house to the Edmonton Iron Works for $16,769.

EDMONTON, ALTA., CAN.—The Government is considering the adoption of automatic telephone instruments throughout Alberta. Hon. W. H. Cushong, minister of public works, is now touring several American cities inspecting the various systems in operation.

CRESTON, B. C., CAN.—A franchise has been granted by the town officials for the installation of an electric light system in Creston.

VANCOUVER, B. C., CAN.—The city solicitor has received instructions to obtain options on water powers within a radius of 50 miles of the city.

VANCOUVER, B. C., CAN.—A company has been organized and the capital secured for an electric car line to tap the country on both sides of Okanagan Lake. The main line will be 100 miles in length, with several branches. John F. Langan, of Chicago, is interested.

VANCOUVER, B. C., CAN.—Announcement has been made that the British Columbia Electric Railway Company will begin work at once on extensions to its railways east of Vancouver, aggregating about 15 miles. The work includes the construction of an initial railway in Burbany, about six miles in length. Contracts have been awarded for preparing the right-of-way for the line on Hastings Street east from Campbell Avenue to the eastern boundary of Hastings townsite, which will require about seven miles of track.

BELMONT, MAN., CAN.—Sealed tenders will be received by Raymond R. Houghton, secretary and treasurer, until May 31 for the complete construction of a rural telephone system throughout the rural municipality of Strathcona, Manitoba. Plans and specifications may be seen at Belmont and also at the office of the chief engineer of the government telephone system, Winnipeg, Man.

ST. JOHN, N. B., CAN.—The New Brunswick Telephone Company has started work on its conduit system. The initial expenditure will be about $18,000, but the entire cost is estimated at $250,000.

STELLARTON, N. S., CAN.—The Pictou County Electric Company, successor to the Egerton Tramway Company, has recently placed orders for engines, generators, condensers, poles, etc., at a cost of about $35,000. The company has recently taken over the property of the New Glasgow Electric Company, of New Glasgow, N. S.

FORT WILLIAM, ONT., CAN.—The Canadian Pacific Railroad Company has decided to install a telephone system between Fort William and White River for the operation of trains.

OWEN SOUND, ONT., CAN.—The citizens on May 15 voted in favor of the by-law appropriating $30,000 for extensions to the electric light plant.

TORONTO, ONT., CAN.—The Hydro-Electric Commission has awarded a contract for copper wire to the Dominion Wire Manufacturing Company, of Montreal. The Ohio Brass Company, of Mansfield, Ohio, will supply the suspended insulators. The electrical equipment of the protective system in the stations will be supplied by the Westinghouse Electric & Manufacturing Company.

MONTREAL, QUE., CAN.—It is reported that the McGill University contemplates the installation of a power plant, to cost $150,000.

REGINA, SASK., CAN.—Sealed tenders will be received by S. P. Porter, deputy commissioner of telephones and railways, until June 1 for the construction of the Wapella-Esterhazy and Gainsboro-Alameda-Carlyle telephone lines. Plans and specifications may be seen at the department.

New Industrial Companies.

THE BROWER ENGINEERING & CONSTRUCTION COMPANY, of Newark, N. J., has been chartered with a capital stock of $100,000 to do a general engineering business. The incorporators are: Joseph N. Barnes and Lawrence E. Brower, of Denville, N. J.; Cecil H. Humphreys, of New York, N. Y.

THE CONTINENTAL SIGNAL COMPANY, of Wilmington, Del., has filed articles of incorporation with a capital stock of $2,000,000. The incorporators are: M. L. Rogers, S. E. Roberson, Harry W. Davis, of Wilmington, Del.

New Incorporations.

MURFREESBORO, ARK.—The Pike County Water Power Company has been incorporated, with a capital stock of $1,000,000. The company proposes to develop water power to be utilized to generate electricity. The offices of the company are: Claudius Jones, president; George A. Showers, vice-president; B. C. Bain, secretary, and E. W. Holmes, treasurer.

AUGUSTA, GA.—Articles of incorporation have been filed for the Richmond Development Company by H. H. Alexander, T. S. Raworth, C. S. Bohler, R. H. Land, Jr.; E. H. Calloway and others. The company is capitalized at $15,000 and has purchased the Richmond factory prop-

erty and proposes to rebuild the dam, develop the water power of Spirit Creek and make other improvements to the property.

CUTHBERT, GA.—Articles of incorporation have been filed for the Cotton Belt Telephone & Telegraph Company by C. J. O'Farrell, Jr., J. G. Dean and J. M. Bell. The company is capitalized at $21,000 and proposes to establish telephone lines in Cuthbert and in other cities in this State.

POCATELLO, IDAHO.—Articles of incorporation have been filed for the Idaho Independent Telephone Company, with a capital stock of $1,000,000, by H. R. Risley and others.

BUSHY PRAIRIE (P. O. LaGRANGE), IND.—The Farmers' Mutual Telephone Company has been incorporated, with a capital stock of $5,000, by Arthur K. Hammond and others.

PORTLAND, IA.—The Portland Heights Telephone Company has been incorporated, with a capital stock of $10,000, and the following named officers: E. L. Bitterman, president; R. B. Pickford, vice-president, and Arthur Pickford, secretary and treasurer.

KEVIL, KY.—Articles of incorporation have been filed for the Kevil Independent Telephone Company, with a capital stock of $1,000.

WELSH, LA.—The Planters' Telephone Company has been incorporated, with a capital stock of $25,000. The officers of the company are: H. E. Wesson, president; W. B. Gabbert, vice-president; John H. Cooper, secretary, and E. C. Willard, treasurer.

LA GRANGE, MAINE.—The La Grange & Alton Telephone Company has been chartered with a capital stock of $5,000. The officers are P. E. Speed, president; W. R. Hunter, treasurer, and A. W. Knowles, clerk, all of La Grange.

INDIANOLA, MISS.—The Sunflower Light, Ice & Power Company has been chartered, with a capital stock of $25,000, by A. F. Gardiner, W. B. Bartin, C. C. Moody and others.

CLAY CENTER, NEB.—The Glenville & Inland Telephone Association has been incorporated, with a capital stock of $10,000, to construct and operate a telephone system in Clay County. The incorporators are J. R. Shawcross, A. Batterman, H. B. Francisco and E. A. Holt.

BATTLE MOUNTAIN, NEV.—The Landor County Power & Light Company has been capitalized for the purpose of installing an electric plant to light the town.

Legal.

PLANT OF THE ROCKINGHAM POWER COMPANY ORDERED SOLD.—In the Circuit Court of Appeals, sitting at Richmond, Va., Judge J. C. Pritchard has entered a decree in the case of the S. Morgan Smith Company against the Rockingham Power Company and the Knickerbocker Trust Company, of New York, N. Y., ordering the sale of the property of the Rockingham Power Company, of Rockingham, N. C., on July 14 at Wadesboro, N. C., the sale being for the purpose of winding up the affairs of the power company. Commissioners appointed to make the sale are W. H. Brown and W. A. Leland, receivers of the power company. The court also authorized the receivers to issue certificates of indebtedness which will take precedence as a lien on the company's property in preference to and in priority to any other indebtedness, or lien now existing against said property. Provision was also made for securing funds to protect the property until the date of the sale in July.

Personal.

MR. HUGO REISINGER has received from the Emperor of Germany the commander's cross of the Order of the Crown of Prussia.

MR. E. J. RICHARDS, superintendent of the Newburgh (N. Y.) Light, Heat & Power Company, has resigned that position, and has joined the forces of J. G. White & Company, of New York City.

PROF. ELIHU THOMSON delivered an address May 14 before the Pittsfield A. I. E. E. section, the subject being "Thunder Storms and Wireless Transmission." The large attendance included many ladies.

MR. MAX LOEWENTHAL, who has been instructor in electrical engineering in the Stuyvesant Evening Trade School, New York, supported by the city, was the recipient at the close of the present term of a handsome silver loving cup from his pupils.

MR. GEORGE G. WARD, vice-president of the Commercial Cable Company, sailed from New York on May 22 on the *Baltic* for London to arrange for various improvements in the service, and, it is said, to make arrangements for a new cable between St. Johns, New Foundland and New York.

MR. H. M. BEUGLER, who was until recently in the service of the Elmira Water, Light & Railroad Company and was also with Messrs. Dodge & Day for some time as constructing engineer, has gone with the Newburgh, N. Y., Light, Heat & Power Company and will have charge of the electrical department of the business.

MR. CHARLES C. STARR, who for the past five years has been manager of the Halifax office of the Canadian Westinghouse Company, has resigned, having been elected president and managing director of The John Starr, Son & Company, Limited, Halifax, N. S., one of the oldest electrical supply and contracting houses in Canada.

MR. CLARENCE E. ROSE has been appointed superintendent of sales in the lighting department of the Little Rock Railway & Electric Company, to succeed Mr. Chas. E. Mathes, resigned. Mr. Rose has been connected with the properties owned by the Newman interests and operated by Ford, Bacon & Davis for the last five years, and his promotion is given in recognition of the services rendered during that time.

MR. ANGUS SINCLAIR.—The friends of Mr. Angus Sinclair, president of the Sinclair Publishing Company and editor of the *Railway and Locomotive Engineer*, will be interested to learn of his recent marriage to Mrs. Mullin, widow of Mr. E. H. Mullin, who was so well known in the electrical field as publicity manager for the General Electric Company. Mr. Sinclair's friends are overwhelming him with congratulations.

MR. U. N. BETHELL.—The Emperor of Japan, upon the joint recommendation of the Ministers of Foreign Affairs and of Communication, has conferred upon Mr. U. N. Bethell, of New York, president of the New York & New Jersey Telephone Company, the Bell Telephone Company of Pennsylvania and the Central New York Telephone & Telegraph Company, the Imperial Order of the Rising Sun. This has been done in recognition of services rendered by Mr. Bethell in giving assistance to the representatives of the Japanese Government who have been sent to this country within the last few years for the purpose of investigating the telephone system and the management of large industrial enterprises. The order conferred is one of great distinction.

MR. PAUL DOTY, second vice-president and general manager of the St. Paul (Minn.) Gas Light Company, was recently elected president of the local Business League, which discharges the same functions as a chamber of commerce or board of trade. The League does excellent work for the community and is highly respected throughout the Northwest. It is quite an honor for a public service corporation official to be placed at the head of such an organization, but the compliment is a deserved one, and is only another proof that no more public-spirited citizens can be found than they who administer great utilities on a broad and liberal basis, seeking the general welfare. In the lighting field Mr. Doty's activities are too well known to need enumeration.

MESSRS. D. PFEIL, A. HETTLER and H. MEYER, of the Siemens & Halske Company, of Berlin, are now visiting this country and will spend three or four weeks in studying electrical and mechanical development in the United States, visiting a number of leading cities and establishments. Mr. Pfeil is a director of the company and in charge of the railway signaling department. Mr. Hettler is works manager at Wernerwerke, and Mr. Meyer is an engineer on the railway staff. Director Pfeil was here last in 1894, and is very much struck with the progress made in the intervening 15 years, especially in the erection of tall buildings. The itinerary of the party has been laid out by Dr. K. G. Frank, the representative of the great German company for the United States. It embraces Schenectady, Niagara, Chicago, Cincinnati, Pittsburgh, Washington and Philadelphia.

MR. ROBERT T. LOZIER has become a special representative of the Engineering & Electrical Securities Corporation, which is a financial company with a paid-up capital of somewhat over $250,000 and a surplus of about as much, of which Mr. J. G. White is the president. To his new duties Mr. Lozier brings a remarkable familiarity with the whole electrical field, accompanied by an unusually wide range of acquaintance in the mechanical field as well. He was one of the earliest "Edison men," dating back to old 65 Fifth Avenue in the early eighties, and has, so to speak, grown up with the art. As an active member of the American Institute of Electrical Engineers, the Engineers' Club and the New York Electrical Society, Mr. Lozier has given many evidences of the ability and popularity that will serve very advantageously in this new and important connection.

MR. H. A. REED.—On May 14 at their home in Newark, N. J., Mr. and Mrs. Henry A. Reed celebrated the fiftieth anniversary of their marriage, when a large number of friends gathered to extend their congratulations upon the jubilee. Mr. Reed is one of the veterans of the telegraphic and insulated wire arts, and his connection with the Bishop Gutta Percha Company covers and includes active participation in all the great modern electrical developments. Among those present were Miss A. Julia Reed and Mrs. F. A. Sawyer, who were bridesmaids at the wedding in 1859. A large luncheon party was given during the day, and in the evening there were about 120 visitors, while scores of congratulatory letters and telegrams were received, including very cordial ones from Rear Admiral Cone and Mr. and Mrs. Henry Watterson, of Louisville. There were also a number of beautiful presents, family and public, including a rich Tiffany case of gilt armored finger-bowls from the leading rubber-covered wire manufacturers of the country, a vase from the Bishop office staff, and a mahogany chime clock from 30 members of the Roseville (N. J.) church.

Obituary.

MR. HENRY H. ROGERS, who died at his home in New York May 19, one of the wealthiest men in America, was largely interested in electrical and kindred enterprises. He was one of the organizers and heaviest owners of the Amalgamated Copper Company, and was interested in a number of other copper propositions. He was vice-president and director in the Atlantic Coast Electric Railway and the Brooklyn Union Gas Company; president and director of the Richmond Light & Railroad Company, and a director in the United States Steel Corporation.

Trade Publications.

FLEXDUCT.—The National Molding Company is sending out a folder of interesting design having for its subject "New Flexduct" flexible tubing. It is in the form of a mailing card folded once, the exterior simulating a section of Flexduct.

RECORDING INSTRUMENTS.—Recording pressure gages for hot blast, top gas, steam and water are featured in Bulletin No. 103 of the Bristol Company, of Waterbury, Conn. Recording thermometers, electric pyrometers, and electric time recorders are also described.

"THE STAMP OF APPROVAL" is the title of a small folder which the Okonite Company, of New York, is distributing broadcast throughout the country. This folder calls attention to the fact that Okonite wires bear the approval stamp of the Underwriters' Laboratories.

GLASSWARE FOR TUNGSTEN LAMPS.—The Gleason-Tiebout Glass Company, of Brooklyn, N. Y., has issued a second bulletin devoted to tungstenware, which is manufactured and designed to supply the demand for efficient as well as artistic glass. Test curves show the distribution of light obtained by the use of the various reflectors listed.

ELECTRICAL SPECIALTIES.—Henry D. Sears, of Boston, Mass., general sales agent of the specialties manufactured by the Weber Electric Company, has issued catalog No. 2 describing the sockets, receptacles, rosettes, cut-outs, cleats, knobs, insulators, socket rings, etc., manufactured by the company. This line was placed on the market less than five years ago, and owing to its design, quality, workmanship, appearance, etc., has won a place in the front ranks.

DISTRIBUTING TRANSFORMERS.—With this title the Westinghouse Electric & Manufacturing Company has issued a handsomely printed 52-page pamphlet (Circular No. 1502), with illuminated cover, having for its subject transformers, lightning arresters, insulators, cross-arms, etc. Considerable space is devoted to underground and overhead construction applicable to congested and scattered districts. Information is also given on potential regulating system. The pamphlet is well written and contains information of value to a central-station man or others interested in the distribution of power by alternating current.

"A . . . CESSFUL ENTERPRISE" is the title of an artistic pamphlet just issued by the Robbins & Myers Company, Springfield, Ohio. The contents of the pamphlet consist mainly of a description of the growth of the company as an electrical manufacturing concern, and excellent halftone illustrations of the plant and offices are shown. A section is devoted to illustrations showing the many applications of Robbins & Myers motors for industrial purposes; also the company's various styles of fan motors, ceiling fans, exhaust fans, etc. In addition to this pamphlet, the company has issued concurrently two booklets, Nos. 72 and 74, describing and illustrating the company's "standard" fans.

Business Notes.

FRINK COAST AGENT.—Mr. W. A. Purcell has been appointed San Francisco agent for I. P. Frink for the general line of Frink's reflectors.

THE MAXWELL-BRISCO MOTOR COMPANY, of New Castle, Ind., has taken the initial steps to establish and conduct a large technical school at this place. It is proposed to expend $100,000 in building and equipment on a site adjoining the company's large factory.

ELECTRIC POWER AT PULLMAN, ILL.—The plans for the extensive electrical additions to the car plant of the Pullman Company at Pullman, Ill., to which reference was made last week, are being drawn up in the main offices of the company in Chicago under the general supervision of Mr. Richmond Dean, the general manager. All machinery in the $3,000,000 additions will be electrically operated, individual motors to be installed wherever practicable. The power house will probably be equipped with steam turbo-generators.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 18, 1909.

[Conducted by Wm. F. Bissing, Pat. Law, 2 Rector St., N. Y. City.]

921,660. AUTOMATIC FIRE ALARM SYSTEM; F. Bain, Chicago, Ill. App. filed Jan. 13, 1908. A piping system which is filled with a fluid so that when heated the pressure of the fluid will vary and operate a signal.

921,661. TROLLEY; C. Baker, Philadelphia, Pa. App. filed Oct. 15, 1908. The harp is elastically supported and can rotate with relation to the pole so as to permit the wheel to follow the wire.

921,665. CONSTRUCTION OF ELECTRIC TRAMWAYS; S. G. Bennett, Heath Town, Wolverhampton, England. App. filed Nov. 16, 1905. A shallow conduit tramway having switches at intervals each with a projecting lever struck by the plow.

921,666. AUTOMATIC SWITCH; C. H. Bierman, Milwaukee, Wis. App. filed Dec. 30, 1908. An automatic switch for changing polarity in car lighting systems comprising a wheel and wedge which is clamped to the wheel to cause it to turn.

921,668. BANDING OR WINDING MACHINE; C. Boderck, Brooklyn, N. Y. App. filed June 10, 1907. Machine for winding bands of wires on armatures.

921,678. SEPARABLE ELECTRIC CONNECTOR; F. C. De Reamer, Schenectady, N. Y. App. filed Dec. 7, 1906. A two-part plug with a base portion of insulating material carrying electrical contacts and a detachable portion with metallic fingers engaging the contacts.

921,686. PRODUCTION OF TITANIUM OXIDE; F. A. J. FitzGerald and P. McN. Bennie, Niagara Falls, N. Y. App. filed Nov. 18, 1907. Crushes the ore, separates it preliminarily magnetically, mixes with a reducing carbon and heats so as to reduce the iron, but not the titanium, to the metallic state; then removes the iron.

921,693. SYSTEM OF DISTRIBUTION; J. L. Hall and A. F. Knight, Schenectady, N. Y. App. filed Aug. 21, 1905. For searchlights where the voltage is regulated by a motor generator.

921,715. TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Oct. 10, 1907. Uses rapidly recurring or induced impulses and polarized relays, together with a localized circuit operated only when no current is flowing through the relays.

921,732. ELECTRIC CUT-OUT; W. B. Potter, Schenectady, N. Y. App. filed Jan. 5, 1905. A thermo cut-out with three or more branches, one for each circuit.

921,740. ELECTRIC RAILWAY; W. G. Roome, Los Angeles, Cal. App. filed Dec. 4, 1902. Supplies propulsion to a sectional third-rail by means of a feed conductor controlled through track circuits.

921,758. SIGNALING SYSTEM FOR RAILWAYS; J. M. Waldron, Yonkers, N. Y. App. filed Sept. 30, 1908. Track circuits lie between the signals and control their movements and a portion of the track circuit is eliminated by the signals after the signals have been set to danger by the train.

921,761. ELECTRICAL SWITCH; I. G. Waterman, Santa Barbara, Cal. App. filed Oct. 6, 1906. Produces a temporary contact snap switch, and prevents the contacts from being held together permanently.

921,768. SYSTEM OF MOTOR CONTROL; H. E. White, Schenectady, N. Y. App. filed Aug. 3, 1908. For controlling motors by means of a dynamic brake by connecting them in a closed circuit through resistance. Makes use of a master switch and a set of switches controlled thereby.

921,784. POLARIZED MAGNET; E. A. Burlingame, San Francisco, Cal. App. filed July 13, 1908. Detailed improvement in polarized relay.

921,786. SYSTEM OF ELECTRIC DISTRIBUTION; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 7, 1908. Generator for three-wire systems for automatically compounding the voltage between the neutral and an outside wire with varying load.

921,800. ELECTRIC LIGHT KEY SOCKET; W. C. Clark, Keewatin, Ont., Can. App. filed March 30, 1908. A push key socket for incandescent lights including a rotable rod having a pin and a cross bar with a set of teeth engaging with teeth on a contact bar.

921,826. ALTERNATING-CURRENT MOTOR; W. E. Goldsborough, La Fayette, Ind. App. filed Aug. 11, 1903. Impedance coils are placed between the coils of the armature and a short-circuiting ring, the impedance being diminished at suitable points to permit passage of current through them and increased at other points so as to prevent leakage of current through them.

921,833. HOLDER OR SUPPORT; F. F. Hespe, Hoboken, N. J., and M. Larsen, New York, N. Y. App. filed Oct. 15, 1906. For concealing wires passing to the lamp socket by means of a tubular ring attachable to the socket and supported between hollow shells.

921,836. WEATHERPROOF LAMP SOCKET; H. T. Hochhausen, Brooklyn, N. Y. App. filed July 25, 1907. A petticoat insulator fits over the base of the lamp socket.

921,839. KEY SOCKET SWITCH; H. Hubbell, Bridgeport, Conn. App. filed Dec. 21, 1908. Comprises a shaft with an angular block loosely thereon and a contact plate at right angles to the shaft and connected thereto.

921,844. IRRIGATING DEVICE FOR ELECTRICAL GROUND CONNECTIONS; Budd J. Jones, Cincinnati, Ohio. App. filed Feb. 10, 1908. A rope is placed around the pole for conducting water to the ground plate.

921,866. ARC LAMP; B. Monasch, Berlin, Germany. App. filed May 8, 1906. For flaming arc lights, having a lower negative electrode and an upper non-consuming electrode with a disk-shaped arcing surface to prevent climbing of the arc.

921,875. FIRE ALARM; A. T. Newman, Greeley, Kan. App. filed June 25, 1908. A fuse plug with a wax fuse holding the spring out of engagement with another contact.

921,893. MULTIPLE OPERATION OF VAPOR ELECTRIC DEVICES; R. E. Russell, Schenectady, N. Y. App. filed Sept. 18, 1905. Connects the vapor devices in multiple and supplies them with alternating current, together with equalizing devices in circuit with direct-current leads and suitable impedances.

921,894. COMBINED AUTOMATIC SIGNALING AND TELEPHONE SYSTEM; E. E. Salisbury, Chicago, Ill. App. filed Nov. 25, 1901. Improvements in systems for fire alarms. Details.

921,903. OZONIZER; E. W. Smith, Philadelphia, Pa. App. filed June 20, 1907. Makes use of a waterjacket and electrodes through which the current passes to ozonize.

921,914. DYNAMO-ELECTRIC MACHINE; A. H. Timmerman, St. Louis, Mo. App. filed Nov. 5, 1906. Means for centering the plates forming the cores of the field and armature.

921,918. SYSTEM OF ELECTRICAL DISTRIBUTION; M. O. Troy, Schenectady, N. Y. App. filed Nov. 11, 1905. For changing alternating current of constant potential into current of constant volume and then rectifying it by the vapor lamp.

921,930. PRODUCING AMPLIFIED CURRENT VARIATIONS; E. Weintraub, Schenectady, N. Y., and M. C. A. Latour, Paris, France. App. filed Nov. 26, 1907. For amplifying current in telephony, telegraphy, particularly wireless, by using a mercury vapor lamp whose resistance varies greatly when the lamp is operated at a voltage less than necessary to maintain an arc.

921,935. INCANDESCENT LAMP SOCKET; A. L. Williams, Waterbury, Conn. App. filed Jan. 11, 1909. Details in a construction of

lamp socket in which the socket and base are locked together automatically.

921,943. PROCESS FOR ELECTRICALLY COATING WITH TIN OR ALLIED METALS; J. C. Beneker, Waukegan, Ill. App. filed June 27, 1907. The electrolytic solution contains sodium hydrate, thio sulphate and tin chloride.

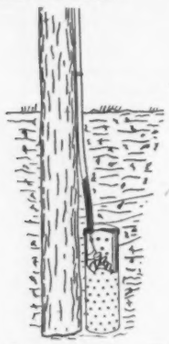
921,959. ELECTRIC VEHICLE CHARGING WALL SOCKET AND PLUG; J. N. Davis, Denver, Col. App. filed March 9, 1908. See title. Details.

921,969. PULL SOCKET; M. J. Flynn, New York, N. Y. App. filed June 26, 1908. A pole socket switch in which a flexible driving member rotates a driven member to make the connection, the latter being returned by a spring.

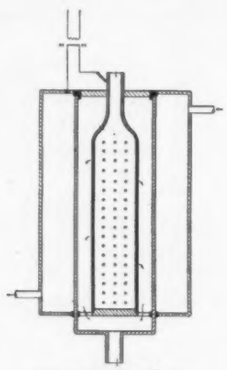
921,970. ADJUSTABLE SUPPORT FOR DROP LIGHTS; P. Frantz, Dixon, Ill. App. filed Sept. 28, 1907. A support for drop lights in which a drum and cord support the light at different elevations.

921,989. AUTOMATIC MOTOR STARTERS; W. F. Hendry, New York, N. Y. App. filed Dec. 21, 1905. A motor starter in which the starting resistances are cut out and the devices locked in running position. Solenoid switches with mechanical self-locking means are used.

922,001. TELEPHONE; E. Koehler, Philadelphia, Pa. App. filed Jan. 12, 1909. Transmits speech by telephone with the transmitter placed against the chest.



921,844.—Irrigating Device for Electrical Ground Connections.



921,903.—Ozonizer.

922,006. ELECTRICAL SIGNALING SYSTEM; A. D. T. Libby, Elyria, Ohio. App. filed May 12, 1906. Uses transformers and circuit changes in harmonic systems of signaling.

922,014. SIGNALING APPARATUS; J. Melvin, Toowoomba, Queensland, Australia. App. filed Aug. 6, 1908. For signaling at night on board ship by illuminating the semaphore arms by electricity.

922,024. TROLLEY SWITCH; C. P. Nachod, Philadelphia, Pa. App. filed Oct. 27, 1908. A longitudinal frame with contact strips yielding laterally and supported on the frame.

922,033. MOVABLE CONTACT FOR ELECTRIC SWITCHES; J. G. Peterson, Hartford, Conn. App. filed Jan. 11, 1909. Details in the construction of a double-pole rotary snap electric switch.

922,034. PUSH-BUTTON ELECTRIC SWITCH; J. G. Peterson, Hartford, Conn. App. filed Feb. 1, 1909. A two-push-button switch in which the shank of one button has a hook which engages with a complimentary hook in the rocker plate of the switch.

922,057. REGULATOR FOR ELECTRIC CURRENTS; T. Spencer, Philadelphia, Pa. App. filed Nov. 25, 1905. A solenoid coil moves an iron core in accordance with variations of resistance in the circuit, thus varying the impedance.

922,079. CELL FOR ELECTROLYTIC OR OTHER PURPOSES; H. S. Blackmore, Mount Vernon, N. Y. App. filed Sept. 24, 1907. Comprises the combination of a receptacle with an electrode comprising carbon and a binder, an opposite electrode and a body of electrolyte.

922,081. ELECTRIC GAS IGNITER; W. D. Brackett, Minneapolis, Minn. App. filed March 2, 1908. A pair of handles of insulating material with a spring yieldingly connecting the handles and conducting rods driven into the other ends of the handles, which rods can be brought together to produce the spark.

922,098. ELECTRICAL TRANSMITTING APPARATUS FOR CONTROLLING THE SIGHTING OF GUNS; A. T. Dawson and G. T. Buckham, Westminster, London, England. App. filed Nov. 20, 1908. Controls the position of an electrically actuated pointer by means of a cam disk situated at the back of the range dial and driven by gearing from the spindle of the transmitter switch.

922,099. POLARIZED RELAY; R. L. Dean, Kansas City, Mo. App. filed Feb. 6, 1908. For printing telegraphs. Employs two tongues, two sets of contact stops and restores the tongues to normal after being actuated by the electromagnet.

922,107. BRUSH RIGGING FOR DYNAMO-ELECTRIC MACHINES; G. Dunn, East Orange, N. J. App. filed Jan. 2, 1908. The brush holder is mounted on a stud. From this it is insulated by suitable insulation, but the stud can be made of metal and connected with the supporting frame, thus securing strength.

922,119. DYNAMO-ELECTRIC MACHINE; J. D. Firmin, Norwood, Ohio. App. filed Feb. 19, 1906. Holds the field coils in place on the poles by means of a clamp which draws the field coil onto a seat on the pole.

922,123. MACHINE FOR TESTING INCANDESCENT LAMPS; T. W. Frech, Jr., Cleveland, Ohio. App. filed Dec. 26, 1905. A rotatable head whirls the lamp so as to show whether the bases have been properly applied to the bulb; if not the lamp wobbles.

922,134. METHOD OF TREATING MILK; J. L. Goucher, New York, N. Y. App. filed Sept. 18, 1906. For freeing milk from bacteria by electrolysis.

922,172. CONTROLLER REGULATOR; C. E. Lord, Norwood, Ohio. App. filed Nov. 30, 1906. To insure a step-by-step movement in throwing the controller from "off" to "full on." Uses a handle and pawl to stop the handle.

922,175. MEANS FOR REGULATING THE SPEED OF PRIME MOVERS AND MOTORS; E. Meckelburg, Charlottenburg, Germany. App. filed Aug. 25, 1908. For hoisting engines and elevators in which the depth indicator driven by the hoisting motor acts upon the controlling means of the motor by means of a variable transmission gear driven by a constant-speed motor.

922,192. RELAY; H. C. Rice, Denison, Tex. App. filed June 5, 1908. Makes use of two armatures—one sensitive, the other insensitive, the latter being substituted automatically for the former when the current becomes abnormally powerful.

922,206. COMPOSITE SIGNALING SYSTEM; H. B. Stone, Providence, R. I. App. filed July 20, 1908. The line circuit is used for simultaneous telegraphic and telephonic communications by means of a repeating coil having all of its secondaries connected in series with each other and with two sides of the line, the primary connected to the telephone branch and a connection from the telegraph branch to line through one of the secondaries.

922,218. AUTOMATIC VOLTAGE REGULATOR; H. L. Van Valkenburg, Norwood, Ohio. App. filed July 30, 1906. A series of switches, a pair of solenoids for each switch, and connections whereby each solenoid when it operates its switch closes the circuit of a corresponding solenoid of the next pair.

922,219. AUTOMATIC VOLTAGE REGULATOR; H. L. Van Valkenburg, Norwood, Ohio. App. filed July 30, 1906. A series of switches separately actuated, some biased to open and some to closed position, and a potential regulator controlled by the switches.

922,230. COMMUTATOR-TYPE, HIGH-SPEED, DYNAMO-ELECTRIC MACHINE; C. J. Yates, Norwood, Ohio. App. filed Oct. 31, 1906. Direct-current turbo-generator in which all parts of the armature projecting beyond the core are firmly held in position by means of end clamps.

922,245. DYNAMO-ELECTRIC MACHINE; B. A. Behrend, Norwood, Ohio. App. filed March 14, 1907. A shaft with a collector ring, a collector lead, a nut for clamping the ring to the shaft and the lead to the ring.

922,309. ELECTRIC WIRE CONNECTOR; F. More, Kingston, N. Y. App. filed Feb. 25, 1908. For securing the wires to the battery cells in a battery chute elevator by means of a special form of connector which clamps the battery leads to the wire.

922,313. INSULATOR; L. McCarthy, Boston, Mass. App. filed Feb. 14, 1907. A screw insulator for joints of gas and electric fixtures having metallic portions separated by laminated insulation.

922,318. AIR-BRAKE SYSTEM; E. J. Newton, Chicago, Ill. App. filed June 27, 1905. The energy of the moving vehicle operates the brake through the agency of an air reservoir, which is filled with air by means of a compressor controlled by electric circuits.

922,320. ELECTRICAL SIGNALING SYSTEM; J. G. Nolen, Chicago, Ill. App. filed Feb. 2, 1903. For fire alarms. Details.

922,333. ELECTRICAL WATER HEATER; Delia B. Rawson, Los Angeles, Cal. App. filed July 8, 1907. An electric water heater with a core having spiral grooves in which the heating element is located. (See illustration.)

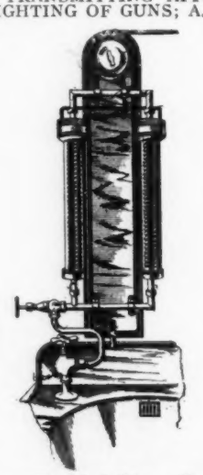
922,360. WIRE ATTACHMENT FOR ELECTRICAL DEVICES; H. Trumbull, Plainville, Conn. App. filed Oct. 19, 1905. For a knife switch in which the wire attachment is formed of bent plate of metal.

922,362. MEASURING INSTRUMENT; H. L. Van Valkenburg, Norwood, Ohio. App. filed Sept. 29, 1908. For measuring variations in current of potential by providing an indicator having a pair of receptacles each with a flexible diaphragm and filled with fluid, the receptacles being connected by a tube, containing the air bubble which gives the indication. The diaphragms are actuated by the core of an electromagnet supplied with current.

922,368. FLOOR CONDUIT AND DETACHABLE COVER THEREFOR; C. W. Wachtel, Jr., Newark, N. J. Improvement in conduit sections for flooring.

922,391. ELECTRIC SIGNAL; P. I. Chandeysson, St. Louis, Mo. App. filed Jan. 25, 1908. Semaphore blade signal operated by an electric motor with a four-pole armature and a four-pole field.

922,399. ELECTRICAL TRANSMITTING APPARATUS FOR CONTROLLING THE SIGHTING OF GUNS; A. T. Dawson and G. T. Buckham, Westminster, London, England. App. filed March 20, 1909. A rotary transmitter switch controls a pointer moving over a range dial and a cam disk actuated by the switch moves the dial.



922,333.—Electrical Water Heater.

922,410. ELECTRIC LIGHTING SYSTEM; C. Feldmann, Delft, Netherlands. App. filed May 24, 1907. For car lighting systems using alternating currents in which when the speed of a car drops the impedance in the lighting circuit is altered so as to maintain the voltage on the lamps.

922,436. ELECTRICAL SIGNALING SYSTEM; R. H. Manson, Elyria, Ohio. App. filed April 18, 1907. For selective signaling in which periodic currents of different frequencies are used. Makes use of a pole changer and transformer, with a key for actuating the pole changer.

922,443. ELECTRIC SWITCH; W. Van. P. Steiger, Bridgeport, Conn. App. filed Nov. 12, 1908. A two-button snap switch having a pivoted contact member with a spring for actuating it. Details.